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THE PRACTICAL TEACHER

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A MONTHLY MAGAZINE AND REVIEW FOR THE SCHOOL-ROOM AND THE STUDY

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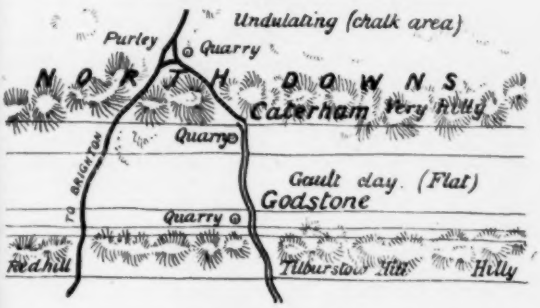
THE SCHOOL JOURNEY—A MEANS OF TEACHING GEOGRAPHY.

(WALKING TOUR.)

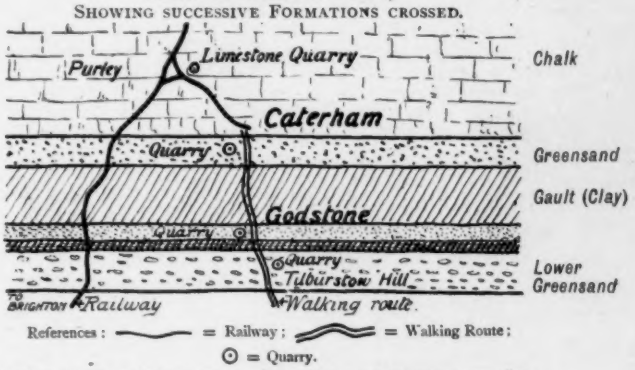
By J. H. COWHAM, *Professor of Education, Westminster Training College, S.W.*

MAP OF WALKING TOUR.



PLAN OF SCHOOL TOUR,

SHOWING SUCCESSIVE FORMATIONS CROSSED.



References : ——— = Railway ; ≈≈≈ = Walking Route ; ⊙ = Quarry.

INTRODUCTORY.

IN an article entitled 'The School Journey' which appeared in THE PRACTICAL TEACHER of June, a full account was written of the preparation necessary before attempting the 'Journey.' In the September number of this magazine an account was furnished of the railway portion of the 'Journey' from Charing Cross to Caterham. At Caterham the railway journey ends, and the excursion on foot begins.

For the purposes of this pedestrian portion of the 'Journey' it will be necessary to recall the following geographical facts. From Charing Cross to New Cross the railway route was over the alluvial tract of flat land bordering on the Thames. From New Cross to Croydon the country assumed a very level aspect, due to the tendency in the clay to slip into hollows, as shown on the railway slopes. At Croydon considerable variety of outline, due to the presence of the sands and gravels of the Lower London Tertiaries, was exhibited, whilst immediately after passing through the hills near South Croydon the long and somewhat monotonous and treeless curves characteristic of chalk scenery was observed.

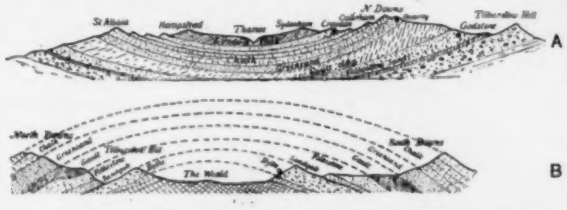


FIG. 1.—A, The arrangement of strata in basin form beneath London. B, Arrangement of strata formerly across the Weald. The dotted lines show the former position of rocks now washed away.

FIG. 2.—Photographic view of hills and valleys at Caterham, Surrey. Photo by Mr. Jos. Kay, Westminster Training College.

PEDESTRIAN JOURNEY—A CLIMB AND A SPLENDID PROSPECT.

A steady climb of about two hundred feet brings the observers to the summit of the North Downs, overlooking Caterham and the road leading to the village of Godstone. The height attained above sea-level is about 600 feet, and from this elevation the view represented by Fig. 2 is obtained. The scholars are evidently delighted with the prospect. For a few seconds it is well to encourage them to survey quietly the beautiful grouping of tree-topped hills, of lawn-like slopes, and of deep valleys. What is the cause of this charming variety of aspect? The question serves to rouse and direct

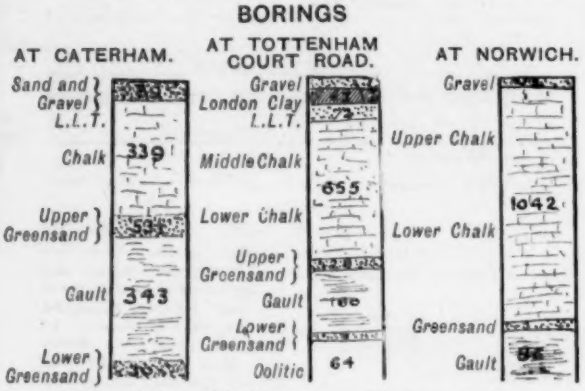


FIG. 3.—Three well-borings sunk in different portions of the London Basin, showing the existence beneath London of the formations walked over during the 'School Journey.'

the scholars' thought; but as yet their knowledge is not sufficient to hazard a reply. Their knowledge must be increased. In order to this, attention is called to the chimney or shaft on the sky-line, a little to the right of the centre of the view (Fig. 2). This shaft is over the boring at Caterham shown in Fig. 3.

Referring to this section, it is seen that on the top there are no less than 83 feet of the sands and gravels of the Lower London Tertiaries, *i.e.* of the same formation which caused the beautifully varied hill and valley structure near South Croydon. (See Sept. PRACTICAL TEACHER.) The scholars are further told that all the chalk hills in the view (Fig. 2) are capped with similar sands and gravel. These gravel-caps resist weathering and yield therefore steeper slopes than would be formed if the chalk existed alone. Here, then, is the clue to the answer of the question asked above, but not as yet answered. Before repeating the question, and in order to deepen the truth which it is desired to impress, the following contrasts may be attempted. With clay alone on the surface, the outline tends to become a dead level; with chalk alone, the surface weathers into long and somewhat monotonous curves; but when a mixture of formations, such as that now before the class, is found, the result is great variety and beauty of landscape.

THE CHALK DOWNS—THEIR EXTENSION OVER THE EAST AND SOUTH OF ENGLAND, FROM FLAMBOROUGH TO PURBECK.

(*a*) *Extension beneath London.*—Attention is now directed to the chalk range of hills on which the scholars are resting. The thickness of the chalk beneath them is 339 feet (see boring, Fig. 3); beneath London at Tottenham Court Road it is 655 feet thick (Fig. 3). This chalk formation passes out of sight near Croydon, five or six miles away, but it does not stop at that point. Tell the class that besides the three borings shown (Fig. 3), there are twenty others in the London area which all show the existence of chalk beneath the surface. Finally, add the fact that exactly the same chalk rock comes to the surface in the Middlesex Heights at St. Albans, Hatfield, and Hitchin. With these facts clearly before them the scholars should be able to state that whilst geographers look upon the Middlesex Heights and the North Downs as separate and distinct features, *they are really one and the same rock-mass, and were originally one and the same deposit.* (Fig. 1 A illustrates this notion.)

(*b*) *Extension of the Chalk over the Weald.*—The scholars are now asked to turn their attention in the opposite direction from that of the view (Fig. 2). They see immediately in front

the long surface undulations of the North Downs scenery. They are now told to try and make out a line of very dim hill-forms on the sky-line some thirty miles southward. Only on rare occasions, *i.e.* on remarkably clear days, are these visible. The scholars are referred to Fig. 1 B. This will help them to understand the somewhat difficult problem before them. The dotted lines in that figure represent the former extension of the chalk southwards in an upward curve, and the connection which once existed between the North and South Downs.

Questions to be asked and answered.—Care must be taken with young pupils not to proceed to too many new ideas at once. Questions like the following help to fix the facts already taken :—

1. What chalk ranges exist north of London ?
2. What evidence have we that this chalk range is connected with the North Downs ?
3. Think for a moment, and then tell me, if you can, why these chalk ranges are now separated ?

(If this question be not answered, it would be necessary to help the scholars to a reply. The chalk mass was covered by the sands and clays already mentioned. Both were then bent into a basin-shape, and so, whilst the upper curves of the chalk are exposed in the Middlesex Heights and the North Downs, the intervening chalk masses are preserved.)

4. What hills in the far south of England were once connected with the North Downs ?
5. What has separated these two ranges of Downs ?

(Fig. 1 B suggests the reply. A fairly clever boy will see that the elevated mass would be exposed to rapid weathering away by rain and river.)

Fig. 4.—North Downs—near view. Photo by J. A. Carter, Esq., B.A., Reedham.

(*c*) *Still wider extension of the Chalk area.*—If the class be sufficiently advanced to attempt still further connections of the hills on which they stand, they may be told that the chalk ranges, which stretch from the Middlesex Heights in a long range towards Hunstanton and Norwich, form another basin, like that beneath London. This time they bend beneath the Wash and the low-lying Fens, and reappear in the Lincolnshire and Yorkshire Wolds, terminating in the region round Flamborough Head. If we leave the North for a moment and turn to the South Downs, we find these also bend beneath the South of Hampshire and reappear in a ridge crossing the Isle of Wight from Culver Cliff in the east to the Needles in the west.

Influence of this teaching upon the Scholars' geographical knowledge.—In future the Yorkshire Wolds, the East Anglian Heights, the North Downs, South Downs, and the Isle of Wight Hills will not be learned as isolated geographical facts. They will be recalled as different portions of one and the same chalk-mass, but now detached because of the downward (or basin) and upward (or saddleback) curves, into which nature, by the exercise of a mighty internal force, has thrown them. In like manner Flamborough Head, Hunstanton, North Foreland, South Foreland, Beachy Head, Culver Cliff, and the Needles will be closely associated, for they are terminations seaward of the series of elevated portions of one and the same formation.

Geography, Science, and Poetry.

The scholars are now impressed with the wide extension of the chalk mass they see before them. A glance at the Harwich boring (Fig. 3) shows a depth of chalk of 1,000 feet, so that at least this thickness of the deposit was originally made. The question, 'What made the chalk ?' naturally arises, and might be asked. A prepared glass microscopic slide, with chalk forms upon it, and a pocket-magnifier suffice to show the shells (tests) of the tiny agent, and thus the question, 'What made ?' is answered. The class is told that the same tiny

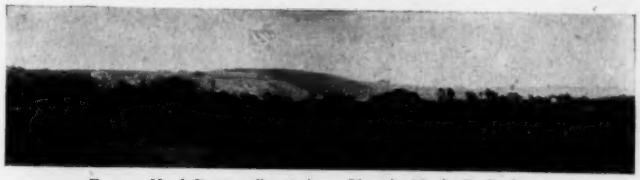


Fig. 5.—North Downs—distant view. Photo by Mr. Leslie Cowham.

living forms are to-day slowly accumulating masses of similar shells (tests) at the bottom of the Atlantic and Pacific Oceans. Allow the class to ponder over the facts just presented, and then ask the following questions :—

1. Was the area extending from Flamborough to Purbeck sea or land when the chalk masses were deposited ?
2. How has the chalk deposit been changed from deep ocean bed to the high land on which you stand ?
3. During the process of elevation, was the chalk mass lifted evenly or was it curved ?
4. In what areas of England is the chalk preserved in basin-like curves ?
5. Name an area where it has been washed away.
6. Direct the attention of the class to the dust that has collected on their feet ; quote the line—

'The dust we tread upon was once alive.'

And ask any boy to explain it.

The journey across the Chalk Downs is completed by a walk of about three-quarters of a mile. Fig. 4 shows the appearance of the surface outline when a near view is taken of the Downs. Fig. 5 shows the appearance of the same Downs when viewed from a distance of about three miles. In both cases the gentle slopes of the surface are distinctly seen.

The Greensand—A Journey Underground.

The intellectual strain of the last half hour is now relieved by entering a quarry having the appearance of a long railway tunnel. After groping along for about three-quarters of a mile, the class reaches the workings. They are now 300 feet below the Chalk Downs upon which they first rested.

The flash-light photograph of this quarry, taken by J. A. Carter, Esq., Reedham, shows the workman at the end of this long underground tunnel (Fig. 6). The head of the quarryman nearly touches the roof, and the width of the quarry is very little more than the height. This underground journey, with its gentle slope downwards, gives the scholars a clear notion of slowly-curved strata. If they consult Fig. 1A, Fig. 1B, and the three borings, Fig. 3, they will readily answer the following questions :—

Fig. 6.—At work in the Greensand Quarry near Godstone. Photo by J. A. Carter, Esq., B.A., Reedham.

1. If continued far enough, where would this tunnel in the greensand end ? (*See Fig.* 1A.)

2. What would be the depth of the tunnel beneath Tottenham Court Road? (*See Fig.* 3.)
3. Why should the greensand be found to the north of the chalk of the South Downs and to the south of the range of chalk hills crossing the Isle of Wight? (*See Fig.* 1B.)

FIG. 7.—Photographic view looking southward over the Gault, with hills of the Lower Greensand on the sky-line. Photo by Mr. Jos. Kay.

JOURNEY ACROSS THE GAULT (CLAY).

After emerging from the quarry, the scholars look northwards for a moment (*see Fig.* 4) at the hills under which they have burrowed. They then turn half round, and looking southward, they view a long stretch of almost level ground (*see Fig.* 7).

The class recalls the appearance of the London clay area, and the resemblance between that area and the gault clay region before them is at once recognised. Their attention is now directed to the nature of the vegetation in the fields—rushes, horsetails, and coltsfoot abound. A specimen of the clay is obtained from the roadside ditch. They consult the borings in Fig. 3 and find that the gault clay follows the chalk. They could now tell why this clay is found in Huntingdonshire and in Sussex, and could readily state the kind of surface found wherever the gault comes to view.

A walk of nearly a mile across the flat and rather uninteresting gault affords the necessary brain rest. The class is merely told to make an attempt to determine where the gault clay ends and the sands of the next formation begin. It is both instructive and amusing to see the efforts made by different pupils to solve the problem. Some stop at a sudden dip in the road; others watch the fields to see where the rushes disappear; the position of some cottages and their well-kept gardens attract some, whilst not a few plod on until they come full in view of the silvery sand of the Lower Greensand beds. The first and second set of observers are to be commended. They have gained the power of acting upon evidence. The last-named observers are, as yet, sure only of that which they see.

THE LAST HILL CLIMB—RESULTS OF AN EARTHQUAKE VIEWED, AND AN OLD WELL-WORN THEORY EXPLODED.

A steady climb of a mile brings the class to the summit of the hills seen on the sky line of Fig. 7. The beautifully-varied scenery here is entirely due to the change from clay to a sandstone that is sometimes hard and at other times soft and pliable. Turning through a gateway on the left of the roadway, near the summit of Tilburstow Hill, the sand quarry, Fig. 8, is entered. The Fig. 8 and its footnote are sufficiently explanatory of each other. Here at a glance the scholars find themselves in the presence of clear but startling effects of those mighty underground forces already mentioned in connection with the bending of the chalk. By means of a climb up the sides of the quarry near B, a view, unequalled in beauty and extent in the south of England, is suddenly spread before the delighted observer.

FIG. 9.—View over the Weald. Ranges of hills are dimly visible beyond the flat Wealden clay area. Photo by Leslie Cowham.

As the scholars look southward over the Weald, they should be encouraged to build up (by an effort of imagination, aided by Fig. 1B), the high ridge of land that once covered the entire Sussex Weald, but which has now been washed away. They should also connect the sources of the rivers Wey and Mole (which now appear to break through the N. Downs) with the summit of this replaced chalk range, and they should understand that the valleys through which these rivers now flow are the remains of valleys which originally reached much further to the south than at present. The Geographers who wrote textbooks thirty years ago were unable to account for the strange phenomenon of a river breaking through a range of hills. An appeal to elementary notions of Geology yields an explanation sufficiently simple and clear to recommend it to the understanding of a class of intelligent youths.

FIG. 8.—Lower Greensand Quarry on Tilburstow Hill. The arrow A shows the direction of the bedding on the left. The arrow B shows the direction of the bedding on the right. This dislocation of the strata (fault) must have been accompanied by earthquake commotion on the surface. Photo by Leslie Cowham.

After a few minutes' rest on the slope of the hill, with a view of 30 miles to rest the eye, the class is disbanded and the school journey is once more over. And yet it is not over, for the knowledge acquired will enable the scholar to connect many of the features of surface geography in the eastern and southern districts of England with well-determined causes. What is, perhaps, of still more value to the scholar is the insight he has gained into the new mode of geographical enquiry. This mode of enquiry will enable the learner to investigate in similar fashion other districts which he may visit, or of which he may read. By such journeys as these, Geography becomes much more than a mere task of learning names; it becomes an exercise of the higher powers of imagination and of reason.

Our Monthly Retrospect

EDUCATION IN ENGLAND.

N.U.T. NOTES, ETC.

BY T. B. ELLERY, F.R.G.S.,
1895-6 *President of the National Union of Teachers.*

Funeral of our Ex-President. The Union has indeed received a heavy blow in the death of one of the most gallant and brave-hearted leaders it ever had.

Those of us who have been in close touch with him have been aware for at least two years that there were dangerous symptoms, but none suspected any immediate collapse.

It is clear he could not fight the shock occasioned by the death of the partner of his joys and sorrows. The sleepless nights, the daily anxiety, told their tale; and our friend, C. J. Addiscott, is no more. I was one of the great gathering which assembled to pay the last token of respect and affection at Stoke Newington, when the earth received all that was mortal of the leader whose loss we so deeply mourn. Several other Ex-Presidents were there:—Messrs. Devonshire, Day, Rankilor, Langler, Sykes, Dawson, Wild, Yoxall, Gray, and Macnamara, and of present officers we had Mr. Waddington, the President, Mr. Clancy, Vice-President, and the Treasurer, Mr. Hamilton. I cannot, of course, in these columns, give anything approaching a report of the proceedings; but I could not allow the occasion to pass without saying just a word or two of the departed leader whom I regarded as a brother, and for whose manly qualities I had so profound a respect.

An honest man—a scholar—a lover of the beautiful—an artist—a gentleman. Such was Charles James Addiscott.

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2. What would be the depth of the tunnel beneath Tottenham Court Road? (*See Fig.* 3.)
3. Why should the greensand be found to the north of the chalk of the South Downs and to the south of the range of chalk hills crossing the Isle of Wight? (*See Fig.* 1B.)

FIG. 7.—Photographic view looking southward over the Gault, with hills of the Lower Greensand on the sky-line. Photo by Mr. Jos. Kay.

JOURNEY ACROSS THE GAULT (CLAY).

After emerging from the quarry, the scholars look northwards for a moment (*see Fig.* 4) at the hills under which they have burrowed. They then turn half round, and looking southward, they view a long stretch of almost level ground (*see Fig.* 7).

The class recalls the appearance of the London clay area, and the resemblance between that area and the gault clay region before them is at once recognised. Their attention is now directed to the nature of the vegetation in the fields—rushes, horsetails, and coltsfoot abound. A specimen of the clay is obtained from the roadside ditch. They consult the borings in Fig. 3 and find that the gault clay follows the chalk. They could now tell why this clay is found in Huntingdonshire and in Sussex, and could readily state the kind of surface found wherever the gault comes to view.

A walk of nearly a mile across the flat and rather uninteresting gault affords the necessary brain rest. The class is merely told to make an attempt to determine where the gault clay ends and the sands of the next formation begin. It is both instructive and amusing to see the efforts made by different pupils to solve the problem. Some stop at a sudden dip in the road; others watch the fields to see where the rushes disappear; the position of some cottages and their well-kept gardens attract some, whilst not a few plod on until they come full in view of the silvery sand of the Lower Greensand beds. The first and second set of observers are to be commended. They have gained the power of acting upon evidence. The last-named observers are, as yet, sure only of that which they see.

THE LAST HILL CLIMB—RESULTS OF AN EARTHQUAKE VIEWED, AND AN OLD WELL-WORN THEORY EXPLODED.

A steady climb of a mile brings the class to the summit of the hills seen on the sky line of Fig. 7. The beautifully-varied scenery here is entirely due to the change from clay to a sandstone that is sometimes hard and at other times soft and pliable. Turning through a gateway on the left of the roadway, near the summit of Tilburstow Hill, the sand quarry, Fig. 8, is entered. The Fig. 8 and its footnote are sufficiently explanatory of each other. Here at a glance the scholars find themselves in the presence of clear but startling effects of those mighty underground forces already mentioned in connection with the bending of the chalk. By means of a climb up the sides of the quarry near B, a view, unequalled in beauty and extent in the south of England, is suddenly spread before the delighted observer.

FIG. 9.—View over the Weald. Ranges of hills are dimly visible beyond the flat Wealden clay area. Photo by Leslie Cowham.

As the scholars look southward over the Weald, they should be encouraged to build up (by an effort of imagination, aided by Fig. 1B), the high ridge of land that once covered the entire Sussex Weald, but which has now been washed away. They should also connect the sources of the rivers Wey and Mole (which now appear to break through the N. Downs) with the summit of this replaced chalk range, and they should understand that the valleys through which these rivers now flow are the remains of valleys which originally reached much further to the south than at present. The Geographers who wrote text-books thirty years ago were unable to account for the strange phenomenon of a river breaking through a range of hills. An appeal to elementary notions of Geology yields an explanation sufficiently simple and clear to recommend it to the understanding of a class of intelligent youths.

FIG. 8.—Lower Greensand Quarry on Tilburstow Hill. The arrow A shows the direction of the bedding on the left. The arrow B shows the direction of the bedding on the right. This dislocation of the strata (fault) must have been accompanied by earthquake commotion on the surface. Photo by Leslie Cowham.

After a few minutes' rest on the slope of the hill, with a view of 30 miles to rest the eye, the class is disbanded and the school journey is once more over. And yet it is not over, for the knowledge acquired will enable the scholar to connect many of the features of surface geography in the eastern and southern districts of England with well-determined causes. What is, perhaps, of still more value to the scholar is the insight he has gained into the new mode of geographical enquiry. This mode of enquiry will enable the learner to investigate in similar fashion other districts which he may visit, or of which he may read. By such journeys as these, Geography becomes much more than a mere task of learning names; it becomes an exercise of the higher powers of imagination and of reason.

Our Monthly Retrospect

EDUCATION IN ENGLAND.

N.U.T. NOTES, ETC.

BY T. B. ELLERY, F.R.G.S.,

1895-6 *President of the National Union of Teachers.*

Funeral of our Ex-President. The Union has indeed received a heavy blow in the death of one of the most gallant and brave-hearted leaders it ever had.

Those of us who have been in close touch with him have been aware for at least two years that there were dangerous symptoms, but none suspected any immediate collapse.

It is clear he could not fight the shock occasioned by the death of the partner of his joys and sorrows. The sleepless nights, the daily anxiety, told their tale; and our friend, C. J. Addiscott, is no more. I was one of the great gathering which assembled to pay the last token of respect and affection at Stoke Newington, when the earth received all that was mortal of the leader whose loss we so deeply mourn. Several other Ex-Presidents were there:—Messrs. Devonshire, Day, Ranklor, Langler, Sykes, Dawson, Wild, Yoxall, Gray, and Macnamara, and of present officers we had Mr. Waddington, the President, Mr. Clancy. Vice-President, and the Treasurer, Mr. Hamilton. I cannot, of course, in these columns, give anything approaching a report of the proceedings; but I could not allow the occasion to pass without saying just a word or two of the departed leader whom I regarded as a brother, and for whose manly qualities I had so profound a respect.

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The Associations continue to send resolutions of congratulation. Since I last reported on this page, the West Yorkshire District Union, the Somerset Teachers' Federation, and the Manchester, Mid-Devon, Great Yarmouth, Exeter, Reading, and Leicester Associations are amongst those which have favoured me with extremely kind and gratifying letters of thanks, etc.

Not the Action of a Unionist. I referred in a former note to the trouble at Linthwaite, and rejoiced in the fact that up to the time of writing, no teacher willing to take the place of the dismissed master had been found. Now, however, I regret to have to say, a Mr. Stead has thought it consistent with his Union principles to accept the post.

It is perhaps unnecessary to add that this person is no longer a member of the N.U.T. How long he will hold the school is a matter of opinion, of course, but I venture to think the ratepayers, and all interested in the question, will have something to say ere long. It is not a far cry to the election of the new Board. To me it is nothing short of monstrous that it should be possible to find *one* teacher ready to step into the shoes of a man who has been wrongfully dismissed. That 'Code of Honour' will have to come along, after all.

The V.-P. Election. The election this year of the Vice-President of the N.U.T. promises to be an unusually interesting and close contest. At the moment of writing there are five candidates in the field:—(1) Mr. J. F. Blacker, of Brighton, Chairman of the Parliamentary Committee, who stood aside for Mr. Clancy on the last occasion, and made many friends in consequence; (2) Mr. J. C. Horobin, M.A., at one time Vice-Chairman of the Law Committee, and now Hon. Secretary of the Cambridge Conference Special Effort on behalf of the Charities; (3) Mr. Marshall Jackman, Chairman of the Organisation Committee; (4) Mr. Tom John, Vice-Chairman of the Parliamentary Committee, and popularly known as the *Prince* IN *Wales;* and (5) Mr. Fredk. Peaker, Chairman of the Finance, Press, and General Purposes Committee. All these have rendered excellent service to the Union. May the best man win! Rumour says we may have other candidates in the field, even at the eleventh hour. Mr. Harry Coward and Mr. S. Hicks, among others, are mentioned. Clearly the "Chair" will not go begging for some years to come.

Music in Schools. As an enthusiast in the matter of really good music in schools, I am always glad to find my brethren selecting something out of the ordinary run of school songs. Cantatas, Curwen's Part Songs, Novello's School Songs, all pay for the trouble spent upon them. Among Cantatas I may mention 'Britannia, Queen of Ocean' (Educational Newspaper Company), 'Robin Hood' (Messrs. McDougall), and a new one, 'Cinderella' (Novello). Quite a humorous piece of work is 'The Frog' (Novello), which would form an acceptable item in any programme. It is extremely well done. I see by the latest Blue Book that the grant for singing has been earned at the rate of 1s. on account of satisfactory instruction by note in 10,511 schools and classes (78·67 per cent.), with an average attendance of 1,227, 608 (88·25 per cent.); and at the rate of 6d. for singing by ear in 2,829 (21·18 per cent.), with an average attendance of 162,712 (11·69 per cent.). No grant was paid in 21 cases, *in 2 of which singing was not taught!*

Songs in the Training Colleges. Writing of school songs reminds me of Sir John Stainer's last Report to the Education Department on 'Music in Training Colleges.' He says: 'Considering that I and my assistant-inspector had to hear in England and Wales last year more than 2,000 songs, it can easily be imagined what serious injury to temper, nerves, and artistic morality might have supervened if the majority of them had consisted of those exacting sentimental ditties which thrive chiefly in the unhealthy atmosphere of the "ballad" concert room.

'We feel that we ought gratefully to acknowledge that we had the pleasure of listening to songs by Mendelssohn 580 times, by Schubert 235, Handel 201, Sterndale Bennet 166, Schumann 82, Beethoven 35, and Spohr 28 times. This accounts at once for 1,327 out of the 2,000 songs, but it must not be supposed that the remaining number were altogether ill-chosen or unworthy of study; I merely mention the facts as a proof of the upward tendency of musical taste among students in training colleges.'

Specific Subjects. I am informed that My Lords have decided that not more than 60 hours' instruction may be given in any specific subject. One could quite understand that a limit of say 60 hours had to be fixed for financial purposes, but why a teacher is forbidden to exceed that limit, should he find it for the good of the children to do so, I cannot for the life of me understand. It may be I am wrongly informed. I hope so. But this I *do* know—I give the information on the authority of a well-known teacher, who assured me Her Majesty's Inspector had so instructed him. Let a teacher, therefore, give 60¼ hours at his peril!

EDUCATIONAL NOTES.

BY CATHERINE I. DODD,
Owens Day Training College, Manchester.

Helen Keller, the Deaf Mute, her Studies.—Sir Joshua Fitch at the Oldham Educational Conference.—Christmas Festivals and Parents' Evenings in Germany.—A Student's Satire on 'Method.'—The Bishop of London on Education.—Educational Articles.

HELEN KELLER, the gifted deaf mute, who has neither seen nor heard since her infancy, is now preparing for a university course, and studying among other subjects Greek, Latin, and Mathematics. The account of her education may be read in the reports published by the Perkins Institution and Massachusetts School for the Blind. Helen was born in 1880. A disastrous illness, when she was nineteen months old, deprived her of both sight and hearing. She was always, except for this illness, an exceptionally vigorous healthy child, and she has grown, in spite of her afflictions, into a graceful and handsome girl.

Her teacher, Miss Sullivan, from the Perkins Institution, has had charge of Helen's education ever since she was seven years of age. Last year Helen passed the preliminary examination for the Radcliffe College—which is the Woman's Department of the Harvard University—in English, elementary and advanced German, History, French and Latin. She took honours in English and German.

The following letter was written by Helen this summer to the editor of the *Silent Worker*, a paper devoted to the interests of deaf mutes, in which she describes her studies:—

'To the Reader of the *Silent Worker*:—

'I send you my most cordial and affectionate greetings; my most sincere wishes for a happy, restful vacation.

HELEN KELLER.'

'My Dear Mr. Jenkins—I cannot write an article for the *Silent Worker;* but I will tell you as briefly as I can in a letter what I have been doing since I left the Cambridge School last December.

'But, before I begin, let me assure you that I am perfectly well. I was not ill when my mother removed me from Mr. Gilman's school. Indeed, I have not been ill enough to have a physician for several years—not since I was quite a little girl.

'My studies at present consist of Greek, Algebra and Geometry. I pursue these studies under the guidance of an excellent tutor, Mr. Keith, assisted by Miss Sullivan. Mr. Keith comes out here once a week and teaches me for three hours. He explains what I did not understand in the previous lesson, assigns new work, and takes the Greek exercises, which I have written during the week on my Greek typewriter, home with him, corrects them fully and clearly, and returns them to me. In this way my preparation for college has gone on uninterruptedly. I find it much easier and pleasanter to be taught by myself than to receive instruction in classes. There is no hurry, no confusion. My teacher has plenty of time to explain what I do not understand; so I get on faster, and do better work than I ever did in school. I still find more difficulty in mastering problems in mathematics than I do in any other of my studies. But I am not discouraged. I am going to conquer them, and right soon, too!

'In Greek I have practically finished the grammar, and am now reading the "Anabasis," and shall soon begin the "Iliad." I admire Greek very much indeed. It is easier to read than Latin, I think, and much more spontaneous and beautiful. I wish algebra and geometry were only half as easy for me as languages and literature! But somehow I cannot make myself

care very much whether two and two make four or five, or whether two lines drawn from the extremities of the base of of an isosceles triangle are equal or not. I cannot see that the knowledge of these facts makes life any sweeter or nobler!

'On the other hand, each language I learn reveals a new world to me. If I sit down to study my "Æneid," new thoughts, new ideas, new aspirations flash out from the Latin words with almost the same vividness and freshness they did when the meaning of my own beautiful language first dawned upon my imprisoned soul.

'Perhaps it may interest your readers to know that I spend as much time as possible in the open air. I take a little walk every morning before I begin work. It is my morning hymn, the key-note of my day. And most every pleasant day, when my lessons are learned, I go wandering into the woods with a dear little friend in search of sheltered nooks, where wild flowers love to grow. Sometimes we follow a little brook through field and meadow, finding new treasures at every step—not only of flower and grass, but of thought and sweet experience also.

'As to plans, I have but one, and that is to take my final examinations for college a year from now. Of course it is my fervent wish and earnest determination to pass them with credit for my teachers' sake as well as my own. Further than this I have not tried to look into the future; the present is so rich in all that makes life sweet and happy, I have no time for dreaming dreams or building air-castles. Sincerely yours,

'HELEN KELLER.'

In order that Helen may work at mathematics without sight, she has to use a mechanical apparatus, including an algebra embosser. She also has to use a Greek typewriter. It required some time to grow accustomed to these machines, but she works quickly now she is used to them.

* * * * * *

On Nov. 4th the first meeting of the Oldham and District Educational Conference was held. The aim of the Conference is to give managers, teachers, and others interested in education an opportunity of discussing educational questions. Sir Joshua Fitch gave an address on 'The True Aims and Work of an Educational Conference.' He contrasted England with some Continental countries, America, and Scotland with regard to their systems of education. Our system, such as it was, was not a manufacture, but a growth out of a long series of experiments and compromises. He pointed out that by means of a conference it was possible to find out what others were aiming at, the limits of their work, what they did, and what they failed to do. They could also find out the resources of higher education, and the best means of helping on promising scholars. Teachers required a large number of intellectual and social interests to fit them for their profession. Their fitness depended not so much on what they knew as upon what they were, what their tastes were, what kind of reading they preferred when they read for their own enjoyment. They had their own lives to lead, their own thoughts to nurture, their own private tastes to cultivate. What was needed was something to broaden the intellectual horizon of the teacher. He counselled them to be on their guard against the narrowing influences of their ordinary school work, and against allowing material interests to have too great an ascendancy over them. He recommended a study of the life of Dr. Arnold. Arnold was a great schoolmaster, but he was a great schoolmaster because he was a schoolmaster and something besides; he cared about ethics and religion, and their relation to social life, and to the pressing needs of the age. He urged teachers not to place too much confidence in Government measures. He thought that it was by encouraging one another to make experiments, and to put the results of those experiments on record, that they would be able to render real service to the cause of education.

* * * * * *

I am reminded by letters from educational friends in Germany of the great interest felt in Christmas. The celebration of Christmas and other festivals forms a valuable connexion between home and school life. The little secrets, and surprises of preparing presents in school to be given to parents at home, the working at garments for the poor, scrap-books for little hospital children, and presents for the school Christmas tree, are all valuable aids towards deepening the children's social and sympathetic interests. I am more and more firmly convinced that the establishment of huge schools numbering up to 1,000 pupils is one of the causes why the children's home and school life become so completely dissociated in our large towns. This is a tremendous loss to the educational training of the children.

True education can be more effectively carried on in schools from 150 to 200 scholars. In connexion with many of the German schools there are what are called parents' evenings. There are social gatherings, in which the parents and teachers meet together with the object of promoting cordial relations between them, and chatting and consulting each other about the children.

* * * * * *

In the *College Magazine* of one of the University Colleges, to which is attached a Day Training Department, I come upon a quaint and charming little article on 'Method.' The writer, who is probably a training student, is poking quiet fun at that much-abused subject known as School Management or Method. I quote some of the passages:—

> '"Method" is a word much used and little understood. The superior person invariably employs it in tones of undissembled scorn. It represents for him all that is most alien to his lofty mind—neatness, precision, a commonplace clinging to facts and statistics, and arrangement of the latter into packets neatly labelled. It means that in examinations the base-minded candidate distinguished by the quality will write legibly, rule lines, use Roman numerals, and otherwise show unmistakably the absence of the magic attribute "feelings," which can never thrive in such an atmosphere.'

This is a quaint exaggeration of the attitude of the ordinary university student to the commonplace virtues of the training student.

Later the writer directs gentle satire against the idea of correlation which is becoming an important problem in methods of teaching:—

> 'In one of his letters Matthew Arnold gives a list of students' lessons which he was condemned to hear in one afternoon. It runs thus: "Avalanches, The Steam Engine, Bricks, India Rubber, Subtraction, The Reindeer, The Gunpowder Plot, The Jordan." These lessons of course were given in the dark ages of method; modern experts manage such things intelligently. With the exercise of a little ingenuity they can even convert the above apalling list into a coherent scheme bearing upon one idea. The person to whom the lesson on "Bricks" was assigned would discourse pleasantly upon the methods of the children of Israel, and "Subtraction" would merely illustrate some obvious transactions of their day. Instead of holding forth on the steam-engine itself, which is both dry and difficult, what can be more natural than to commence with primitive methods of travelling? These could be illustrated from Egypt suitably. Then one could pass by easy transitions to Solomon, and how his ships went to Ophir, where doubtless they got india-rubber. And then of course Napoleon fought in Egypt beneath the shadow of the pyramids, besides crossing the Alps among avalanches. Thus the whole list could be carefully worked in and made interesting and attractive by the help of despised method.'

* * * * * *

This student's way of leading round and up to the subject reminded me of some of the remarks of the Bishop of London's address at Sion College. The Bishop thinks that besides reading, writing, and arithmetic there ought to be no 'subjects' taught at all in school except things in general. He would not teach history to a child in the elementary schools by beginning with the Witenagemont and going on to the Norman Conquest. He would prefer to lead the child to an appreciation of constitutional history by such questions as this: 'If a man got drunk what would happen to him? He would be taken up. By whom? The policeman.' It was in this way that children liked to have things explained, and it was this form of constitutional history that would appeal most to the child, because the child would be glad to learn the necessity for the policeman's interference. The Bishop declared that 'in maintaining a child's attention, in stimulating his curiosity, and in developing his powers of observation' consisted the true meaning of education. The test of a teacher's work was the desire the child felt to

learn for himself, when the teacher's authority ceased, and there he feared our educational system as at present organised almost entirely broke down.

This is a candid statement of the case. Teachers are employed in storing children's memories with facts instead of giving them right interests, and Boards, Councils, Departments and Inspectors are engaged in testing the accuracy of the facts the children have acquired. If we could only calculate in our examination methods the vitality and variety of the interests that have come into a child's life by means of his school instruction, rather than the number of facts he has learnt, we should be able to judge more truly of the value of the child's education.

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The September number of the *Westminster Gazette* opened a correspondence on the 'Feeding of Public Schoolboys,' and the *Daily Mail* has been discussing 'Corporal Punishment,' in which all the old arguments are revived. *The Parents Review* for November contains an interesting article on 'Observation,' by Dr. Laing Gordon, and a paper by Miss Louch, of Cheltenham, on 'The Education of Children from Three to Seven Years of Age.' The last paper was read to the British Child Study Association.

E.I.S. NOTES, ETC.

BY JAS. PATERSON.

Ex-Vice-President of the Educational Institute of Scotland.

The New Method of Inspection. Mr. Whyte, H.M. Inspector for the Perthshire district, having been asked by the Perthshire branch of the E.I.S. regarding the new method of inspection, has given a reply which the members consider highly satisfactory. Mr. Whyte states that the first year of working must of necessity be tentative on the part of both teachers and inspectors, and nothing short of actual experience will determine what may fairly be expected. It will be best, he thinks, that teachers should work along the lines indicated in the changes already made, without troubling too much about inspectors or inspection. He says it is now quite evident that an intelligent grasp of the subjects studied, and not a crammed knowledge of details, is what will pay best educationally.

Professor Laurie's Opening Lecture. Professor Laurie, in opening the Education Class in Edinburgh University, spoke of the present position of educational affairs. Referring first to primary schools the professor said the Code was now a good code, but it was not perfect, nor would it ever approximate perfection till it brought what were called the Class Subjects—History, Geography, and English—into the compulsory ordinary work of the school. He could not but think that it would relieve the Department of much paper work if the grants were given in a lump sum on the average attendance, provided a school were found to be carrying out efficiently the Code programme. Specific subjects, he thought, might then be abolished, and Elementary Science should, in his opinion, share the same fate. Speaking of the new Higher Grade (Science) Schools he said that, as these were confessedly established for the fitting of boys and girls for industrial and commercial occupations, one foreign language, taught practically, ought manifestly to be included. Scotsmen, he maintained, should manage Scottish educational affairs in Scotland.

Scotch Education Department. The Lords of the Committee of Council on Education in Scotland have appointed Mr. R. A. Johnson, B.A., New College, Oxford, to be a junior examiner in the Scotch Education Department.

Dr. Dunn, H.M.I., on the Leaving Certificate. At a meeting of the Secondary Education Committee of Fife County Council, Dr. Dunn, H.M.I., pointed out that nothing could be more fallacious as a decisive test of the efficiency of a school than the results of the leaving-certificate examinations. Some pupils were presented more than once in the same grade of the same subject, and he had known of cases where parents had insisted on their children going forward to these examinations against the advice of the teachers. The financial condition of the schools had also a deal to do with the results.

Sloyd Association of Scotland. A circular has been issued by the Educational Handwork or Sloyd Association of Scotland to members of School Boards, County Councils, and those authorities to whom is intrusted the distribution of public money in the interest of national education. The circular notes that there is a pronounced and rapidly spreading belief in the efficacy of manual training, and that Scotland is now awakening to the value of such training, not merely with reference to its direct utility, but more especially as likely to affect the intellectual development of her young people. The association is able to report that considerable progress has already been made in establishing central classes, the success of which is considerably advanced by grants from certain school boards for the cost of material and instruction, and for payment of the railway fares of teachers from a distance desirous of profiting by the classes. It is confidently expected by the association that the recognised advantages to education, flowing from such expenditure, will induce educational authorities generally to extend their assistance in this special direction.

Presentation to Mr. Forbes, Springfield. The members of the Fifeshire Branch of the E.I.S. have presented Mr. Forbes, Springfield, with a token of respect and esteem on his retiral from the office of secretary of the association. For over 30 years Mr. Forbes has been an active member of the Institute, and for the past 12 years he has acted as secretary of the local branch. On his demitting office in June last a movement was set on foot by the teachers in Fife to mark by some tangible token their appreciation of his services in the cause of education. The result was the presentation of a very handsome drawing-room clock in brass, along with a highly-artistic standard lamp, also in brass. Over a hundred ladies and gentlemen were present.

The New Education. At the recent meeting of the Fifeshire Branch of the E.I.S., Mr. Blackstock, F.E.I.S., of Dunnikier School, Kirkcaldy, read a paper on 'The New Education,' in which he drew attention to the greater freedom now possessed by teachers of educating their pupils along lines approved by their private judgment, a method which resulted in a more natural style of education, a more sensible curriculum, an enhanced zeal on the part of the teacher, a more pleasurable and profitable period of school life to pupils, and a better moral atmosphere in which school life would flourish. He concluded by emphasising the necessity of inculcating, by systematic instruction, those principles of morality, which alone render of value to the State and the individual the intellectual results secured with so much labour and pains during the school course.

Presidentship, E.I.S. After the reading of the foregoing paper, Mr. Macleod, Leslie, proposed Mr. Blackstock as President of the Institute, a proposal which was accepted with enthusiasm. Mr. Macleod said Mr. Blackstock's claims to the honour were of the strongest nature. His ceaseless and untiring efforts in the interests of the Institute had lasted over many years. He had filled important offices on many of the committees, had occupied the position of Vice-President, had successfully devoted unwearied service to the cause of superannuation, and had fought a good fight in favour of the departmental system. In addition, he was noted as an educationist of the first rank, and held the respect, not only of the local branch, but of many branches within the country to which he was known, as well as of many branches of the Assistants' Association, in which he had from the beginning taken a warm and helpful interest.

Aberdeen Branch, E.I.S., and the Superannuation Act. A committee of the Aberdeen Branch, appointed to consider the Superannuation Act, has reported to the following effect:—The committee regard the Act with satisfaction, in so far as it establishes the principle of superannuation and of compulsory retirement of public school teachers; they recognise the importance of contributions by teachers in providing superannuation allowances; they approve of the break-down clause, but consider the age for retiral too late, especially in the case of female teachers; they regret the utter inadequacy of the contributions other than those from teachers, and also of the pensions generally; they consider that the taking away of the rights of School Boards to give supplementary pensions is unnecessary, uncalled for, and unjust alike to School Boards and existing

teachers, inasmuch as the responsibility of providing the whole retiring allowance of teachers who do not accept the Act is thereby made to rest upon the School Board. The committee are of opinion that amendments on the Act at an early date are urgently required and absolutely necessary, and recommend that the Branch should overture the General Committee to take such action as shall secure the amendments desired.

Secondary Teachers' Association, Edinburgh Branch. At a recent meeting of the Edinburgh Branch of the Secondary Teachers' Association, Mr. James Oliphant, the President, after an appreciative paper by the Rev. W. A. Heard, Head Master of Fettes College, on 'Dr. Arnold,' delivered his retiring address. Mr. Oliphant discussed at some length the recent speech of Lord Balfour of Burleigh at Paisley, and raised the question whether all idea must be abandoned of providing boys belonging to any class of the community with an education which, up to the age of fifteen at least, would be liberal in the highest sense, by which he meant that that education should be adjusted to form the best preparation for life as a whole, without the slightest regard either to artificial standards or to the demands of any particular calling. He argued that if the curriculum of the secondary schools could only be reformed on that basis, not only would there be the greatest gain to the pupils who would attend these schools in any case, but the distrust of many who now refused to enter them would be almost entirely removed, and there would be an end to all competition from extension of the elementary system. If pupils from the elementary public schools could pass without any break of continuity into the existing secondary schools, and could feel that they would continue to receive an education that would be of genuine value to them, even though it had to end at the age of fifteen or sixteen, and though it had no immediate relation to any particular calling, the demand for a premature specialism on the industrial side would be discredited, and the threatened rivalry would lose all its present justification.

'Scotch Education Department,
'15th November, 1898.

'SIR,—In order to obtain a certificate, candidates must pass in Geography and History, but if they qualify in these subjects, either at the Queen's Scholarship Examination or at the first year Certificate Examination, they are relieved from the farther study of these subjects; and it is not open to them either to take Geography and History again or other subjects in lieu thereof.

'I have the honour to be, Sir, your obedient servant,
'H. CRAIK.'

A 'VISIT OF INSPECTION.'

Messrs. Charles and Dible, the well-known publishers and manufacturers of requisites for **Kindergarten Teaching,** and **Hand and Eye Training** have recently removed to No. 10 Paternoster Square. Being informed of their removal, we have since paid a visit of inspection to the very commodious premises in which their business is now carried on. There we found conveniently displayed a really extraordinary variety of materials and apparatus for the multitudinous forms of practical and amusing games, lessons, and exercises that have so large a share in the modern methods of teaching young children. Instead of attempting to catalogue what we saw, we will simply mention a few of the novelties, and then suggest that any kindergarten teachers who wish to make acquaintance with the latest appliances, should call at 10 Paternoster Square and see for themselves. To meet the requirements of the early stages of brush work, Messrs. Charles and Dible have brought out a capital series of cards—**The Helpful and Humorous Brush-Work Cards.** For practice in embroidering, there is a great variety of cards, on which flowers, fruits, figures of children, and common objects are figured, as well as texts, and the months. There are also sets of **British Models for Embroidering,** which can be made up into useful fancy articles. **Quill Work** strikes us as quite new. It is something like pea and stick work, but the materials are quills and glass-headed pins. **Mosaics** for laying patterns in coloured card, are likely to make an interesting occupation. These are made at the publisher's works; and in nearly all cases we understand the apparatus on sale is made not in Germany but in England. We notice an ingenious contrivance for teaching the making of geometrical forms by twining string round beads of different colours placed at certain points on a circular frame. This is a patent of the publishers. Some capital action songs were brought under our notice, of which **The Birdies' Fairy, Butterflies Gay,** and **Little Milkmen** seem to us very tuneful and pleasing. In the department for upper school requisites, we see models and tools for clay modelling, and other forms of Hand and Eye Training: and a series of maps for tracing and colouring, with geographical facts arranged on the opposite pages. These are known as the **Beaumont Geography** series. In Messrs. Charles and Dible's new show rooms there is ample evidence of the firm's initiative in the production of original specialities for the use of Kindergarten and other teachers, and we hope our readers will take an early opportunity of examining all the good things exhibited at No. 10, Paternoster Square, London, E.C.

INTERNATIONAL CORRESPONDENCE FOR TEACHERS.

LEARNING A LANGUAGE BY LETTER WRITING.

AMONGST the letters we have recently received on this subject was one from a teacher who attributed his success in French at the Matriculation Examination to his having supplemented his study of the language by correspondence with an 'instituteur' through the scheme advocated in our columns. This suggests that some of the many teachers who seek pleasant and profitable occupation for the long winter evenings in a course of study, and who consider the practical knowledge of a modern language very desirable, might do well to include in their programme the practice of international correspondence.

Those who think of spending spring or summer holidays on the Continent would undoubtedly find much advantage in friendly intercourse by letter with some *confrère* in the country they propose visiting.

From Armand Colin & Cie. we have received more than one appeal for lists of would-be correspondents to be placed in communication with French teachers whose names have been sent to their bureau. We have responded to these requests by sending all the names and addresses we have received; and we now invite any other of our readers who wish to improve their knowledge of French to send in their names and addresses, with such information as may facilitate the arrangement of suitable pairs.

The scheme of international correspondence continues to develop in new directions. In *The Review of Reviews* just issued, we find the following 'noteworthy proposal.' M. G. Vaché, Head Master of a large technical school near Bordeaux, says his boys can write English, but cannot speak the language. 'He therefore offers to provide board, lodging, teaching, and washing to two or three English boys of about sixteen, for £16 a year, on condition that they will help his boys to speak English.' This is a striking instance of a new departure, and the editor of *The Review of Reviews* quotes other offers to take English students as boarders.

Université Hall, 95, Boulevard St. Michel, Paris, is a kind of international club, which admits visitors of foreign nationality under regulations carried out by a *Comité des voyages d'étude.* A special course of study is being arranged for the Christmas holidays.

From the November issue of *L'Etranger, l'organe de la Société d'Etudes et de Correspondance Internationales,* we learn that the number of members in this society is steadily increasing, so that the committee feel bound to give notice of an early advance in the admission fee. A German correspondent suggests in the columns of this journal that a portion of its space should be devoted to a linguistic corner —*un coin linguistique*—in which questions may be asked and answered on such points of language as dictionaries do not elucidate. The editor accepts the suggestion.

> 'Les lecteurs de notre *Etranger* sont invités à vouloir bien contribuer, en repondant à ces questions, à ce que notre "Coin linguistique" devienne un *thesaurus* de renseignements tel que nul dictionnaire ne pourra jamais l'être.
>
> 'Toute langue vivante change de jour en jour. Les expressions, la prononciation, la grammaire varient selon les temps et les lieux. Personne n'est en état de composer un dictionnaire parfait.'

By way of beginning, the German correspondent, Dr. Joh. Hertel, propounds a series of questions on difficult expressions in Daudet's story of *Tartarin de Tarascon.* We print this proposal as affording a hint of the kind of subject on which even advanced students of the French language may profitably correspond.

NOTES FROM THE NORTH.

Secondary Education. In Scotland, Secondary Education is in the air. During the past month no part of our educational system has absorbed so much attention as that of Secondary Education. This is due in the first place and largely to the prominence given to the subject by Lord Balfour of Burleigh in his speech at Paisley, of which I had occasion to write last month. It is also the direct result of the transference of the Science and Art administration to the Scotch Education Department. We are, indeed, at the parting of the ways, and it is well at this stage to have a thorough discussion of the plans proposed for future re-organisation so that some solid basis of agreement may be found, some definite line of action adopted. The problem is an intricate one, and is in many respects beset with greater difficulties than that of primary or even of university education.

If the problem is to be solved—and the sooner it is solved the better for various reasons—it will only be by taking edution out of the region of party politics. Education requires to be raised to a higher plane, and should not be made the cat's paw of party politicians. Too long has it suffered from this evil, and it is evident from Sir John Gorst's most recent utterances that the evil is increasing, so that the scope of even our primary education is being restricted and its growth stunted.

At present it may be said that between Primary and University Education there is a great chaos, across which party politicians are striving to throw a bridge to their mutual discomfiture. Secondary Education is in a somewhat anomalous state in Scotland, and the difficulty is to reconcile or to remove the existing incoherences. The re-organisation must ere long be seriously undertaken, and it may be that, as the result of the interest at present felt in the subject, we are within measurable distance of some change for the better.

It may be necessary at this point to make clear what is meant by Secondary Education. In Scotland Secondary Education embraces all education between the passing of the Sixth Standard and the entrance to the University—between the obtaining of the Merit Certificate and the passing of the University Preliminary Examination. This work was in large measure done by the old Parochial and Grammar Schools. This definition, sufficiently wide and comprehensive, includes under Secondary Education,—Technical, Scientific, Commercial, and Industrial Education. It embraces all the avenues which begin to diverge as soon as the Merit Certificate is obtained, and which converge—or rather should converge again—on approaching the University.

DR. GEORGE OGILVIE,
Ex-Headmaster, George Watson's College, Edinburgh.

Mr. Haldane, M.P., speaks on the Subject. Mr. R. B. Haldane, M.P., who has done good work in connection with the London University Bill, is a disciple of Mr. Williams, the author of 'Made in Germany,' and is strongly of opinion that the superior knowledge, the better technical training, and higher education of Germany put the workmen of that country in a far better position than those of the mother country. The industries by which the people of this country in the past gained their livelihood, the enterprises in virtue of which Britain had been able to command the foreign markets, and proudly assume the foremost commercial position in the world were maintained by superior scientific equipment. This position is in grave danger. What is demanded, he says, is to give the children attending our schools the best training to their intelligence. This can be done, and should be done in the ordinary primary school, and thereafter they should be equipped with the special knowledge needed for their own particular vocation. In short what was done in the case of their professional men, must be done for the children of the working classes. He would Germanize our education. There ought to be better provision for secondary education; there ought to be something like the German Gymnasium, which corresponds to the French Lycée, where the training is chiefly literary and designed to carry pupils, by way of the University, to the professions. There ought also to be something similar to the German Realschule, designed for practical men, who may or may not complete their studies at the University, but at the same time intended to give prominence chiefly to scientific study or to commercial subjects, and which made it its chief object to train scholars in the very best knowledge likely to be useful to them in business, in commerce, or in industrial art.

Mr. Haldane thought that the Scottish Universities, though admirable institutions, were wholly remote from the industrial life of the people. The Technical University of Leipsic or the great Polytechnic of Dresden was the pattern he would like to see followed.

Optimism and Pessimism in Education. Lord Balfour was somewhat optimistic in his outlook on Secondary Education: Mr. Haldane might be said to be pessimistic. There is need, however, for men of both classes, if we are to make true educational progress. We require the man who, seeing the dawn of a new era in Secondary Education, strives to raise others to the point from which it may be discerned. We need the man, too, who can paint in blackest colours the picture, for he, also, may rouse his countrymen to better things. Both of these attitudes, if they are faults, lean to virtue's side. But what shall we say of the disposition 'to-rest-and be-thankful?' To our mind this attitude is simply impossible in education. There is no finality in education; the potentialities are so great that the *laissez-faire* policy is untenable. We may gain much, and certainly we lose nothing by optimism in education—a sound and high ideal before us, even if we cannot attain to it.

The Marquis of Lorne adds his Contribution. The Marquis of Lorne, at the opening of the new High School at Falkirk, touched on the question. He thought that in all probability in the course of the next few years a greater amount of attention would be given to those subjects which had been called the modern-side preparation in technical subjects, chemistry, and other matters of that kind which went to make technical training so remarkable in the States, Switzerland, and Germany. It was probable that they would find rising in thickly-populated districts large technical schools, and he thought it would be wiser if assistance were given to a few of those technical colleges, than that the votes or grants should be scattered over too wide an area and over too large a number of schools, because the higher they went in this kind of education, the more necessary it was to incur considerable expense in laboratories and other arrangements. He advocated the old German plan of the 'wanderjahr,' or year of wandering, by means of travelling scholarships and bursaries.

Professors Saintsbury and Laurie approved very much of the plans sketched by Lord Balfour of Burleigh.

Lord Reay gives some good Advice. Lord Reay, at the opening of the new Leith Academy, made an interesting contribution to the subject. From his position as Chairman of the London School Board, he is in a position to know something of primary education, while from his official connection as President of the Association for Promoting Technical and Secondary Education he has had an intimate acquaintance with Secondary Education.

The separate control of science teaching such as was the case under the South Kensington regime made systematic organisation of secondary education an impossibility. Lord Reay deprecated any complete separation of literary and commercial from scientific training, and urged that a certain tincture

of literature and commercial training must be permitted to liberalize the purely scientific course. He maintained that a school which would attempt to teach only science would give a very one-sided training, and its pupils would not in after life have any reason to be grateful for their education. Science should not be predominant in any but a limited number of secondary schools. To make science the special object of favour will simply create new vested interests.

As the report of the Royal Commission on Secondary Education put it, 'there must be a healthy balance between science and literary subjects.' He thought Higher Grade Commercial Schools were needed as much as Higher Grade Science Schools. He would discourage an undue multiplication of schools for pupils leaving school at the age of 15 or 16, 'in which the predominant element is science,' and the abandonment of higher or secondary departments in Board Schools.

He was also of opinion that the scope of the teaching of the Universities should be widened.

Conclusions. As a result of the various speeches delivered during the month on the subject, I would sum up the more important conclusions as follow :—

1. A sound general education should precede any special training. The foundation of a thoroughly efficient primary education must be laid, and the perfecting of the mental powers of the child must be aimed at. The merit certificate fixes the ultimate standard to which children in primary schools should attain. If the primary schools can succeed in establishing this standard, they are making no slight contribution to the educational need of the country. To create a well-ordered building of three stories—to use the metaphor employed by Sir William Harcourt in a recent speech—the foundation must be sound and solid. Besides, the building must be harmonious, the structure architecturally complete.

GEORGE WATSON'S COLLEGE, EDINBURGH.

2. If Secondary Education is to be organised, systematic and potent, there must be a Ministry of Education, with a Minister of Education at its head, and an Executive Council to take in charge the whole of education. It may even be necessary, as Professor Laurie suggests, that Scotsmen should manage Scottish educational affairs in Scotland, with a managing department in Edinburgh.

3. There must be a co-ordination of agencies; this, of course, would be a necessary sequence of the above. At present we have a plethora of agencies, all doing pretty much the same work. Instead of dissipating the grants on petty doles over large areas, we must unify and centralize. As one puts it, 'Where one big wheel can do the work, and do it more efficiently, why have a dozen little wheels, which are continually putting each other out of order?'

4. I would say, put the scheme of secondary education into working order. Remedies will suggest themselves; there is little fear of 'vested interests.' If not, code after code, circular after circular will go for so much waste paper. It may not be possible to overcome the traditions of Scottish Education, and have Science Schools established in separate buildings. It may be found that the scientific can best be worked alongside of the classical or literary. It will not do to rush to the opposite extreme of anti-classical or anti-literary.

A compromise seems to be the best way of solving the difficulty. In large towns there should be set apart a more or less limited number of schools, each giving secondary education on one of these lines. In other places, however, alternative courses must be offered in the secondary department of the same school.

Important Appointment to George Watson's Boys' College, Edinburgh. As showing the intimate connection that exists, and has always existed, among the different parts of our Scottish educational system, reference may be made to the appointment of Mr. Wm. L. Carrie, M.A., to the Head Mastership of George Watson's Boys' College, Edinburgh. Mr. Carrie succeeds Dr. George Ogilvie, one of the famous Ogilvie family which has done so much to uphold worthily the true educational spirit of the North, and one who is himself a living embodiment of the unity of Scottish education from the Primary School to the University.

Mr. Carrie, after serving a full apprenticeship as pupil teacher in a primary school in Arbroath, entered Moray House Training College, where he was trained in the principles and methods of education under Dr. Maurice Paterson. Taking the usual arts course in Edinburgh University, he graduated with First Class Honours in Philosophy, and secured the Bruce of Grangehill and Falkland Prize for Metaphysics. He also distinguished himself in Education, which he studied under Professors Meiklejohn and Laurie.

For seven years he acted as Assistant to Professor Masson in the English Literature Class. At present he is Examiner in Education for the M.A. Degree and the Schoolmaster's Diploma at Edinburgh University.

For upwards of fourteen years he has held the position of Head English Master on the classical side of George Watson's College. Since the institution of the examinations for the Leaving Certificate by the Scotch Education Department, his pupils have been remarkably successful, especially in the Honours Grade, in some years securing one-half of the certificates of that class awarded to the whole of Scotland.

Mr. Carrie's course is a standing proof of the solidarity and continuity of Scottish Education, and at the present time, when it would seem as if efforts were being made in many and influential quarters to divorce some of the stages from each other, it is interesting to point to such a career. The traditions of Scottish schools have always maintained that the pupil teacher of our Primary school might reach the highest appointment in the Secondary School and even in the University.

Chemical Woodpulp.—The sulphur industry at the Oliveto Citra Mines, in the province of Salerno, Italy, had suffered a good deal of late years because of the decrease in the manufacture of gunpowder, but there has lately been quite a boom in sulphur owing to its use in making chemical wood-pulp for paper mills. The chemical analysis of sulphur from the mines gives from 60 to 75 per cent. of pure sulphur, which has been found to be very easily reducible to an impalpable powder.

The Luminosity of Sugar.—An almost continuous luminosity has been produced by a hammer striking automatically the rim of a rapidly rotating wheel of sugar (obtained by cutting up a sugar loaf into a number of discs). The wheels or discs were about an inch thick, so as to stand the violent hammering, while the hammer was of the nature of a pendulum about four feet long, which was drawn aside by an electric-magnet and then let go. The spectrum of the luminosity was confined to the more refrangible end of the spectrum, commencing near F, but it was difficult to determine exactly where. To overcome the difficulty of the sugar wearing rapidly, the whole apparatus was fixed on rollers, moved slowly along at a suitable rate to compensate for the change in the position of the sparks which would otherwise take place, and by that means the almost continuous luminosity was made to occur always along the axis of the collimator of the spectroscope. The light seems to be produced by some change in the configuration of the crystals of sugar, or by some sort of chemical action set up between the sugar and the surrounding air at the freshly formed surfaces.

EDUCATION ABROAD.

BY E. E. FOURNIER D'ALBE, B.SC., A.R.C.S.

WHEN the German Emperor visited the schools established by the German Colony in Constantinople, he may hardly have been aware of the fact that the streets leading to them had been newly paved for the occasion by the Turkish authorities. One of these schools is the orphanage established by the German Aid Society after the Armenian Massacres in 1896. It at present shelters 120 Armenian orphan girls. They are educated to the various pursuits of life, some as teachers and governesses, some as cooks and housekeepers, and some as servant girls, who are very popular with the German ladies in Constantinople, being more reliable and industrious than the Greek girls. A High School for outside girls is attached, at which German, English, French, and Turkish are taught.

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Queensland, says the *Christian World*, is said to be more completely secular than any other colony. It began its primary education work within a year of its being formed into a self-governing commonwealth, and naturally followed as its basis and exemplar the system introduced by the Royal Commissioners for Ireland, and actively at work in New South Wales in 1859, the time of the separation of the territory now known as Queensland. But the defects of the managerial system soon became apparent, and in 1881 all State education was declared free, compulsory, and non-sectarian. All sectarian schools, except the Catholic ones, disappeared in consequence. Religious instruction was made purely voluntary, both as to ministers and pupils. But owing partly to the ministers' lack of pedagogic training, and partly to the inertia of the children, even that provision is practically a failure.

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A strong committee has been formed for the holding of a German National Festival on the Niederwald, near Rüdesheim, in the year 1900. It is to consist of national games and competitions, and to be enhanced by a lavish display of Germany's artistic resources and accomplishments. The choice of the Rhine for the scene of the festival is a most appropriate one, since that glorious river was the watchword of the armed millions whose military successes led to the unification of the Fatherland. At the same time one cannot help thinking that there may be an undercurrent in this movement directed against the moral effect of the Paris Exhibition in the same year. But whether this is so or not, the conception is an admirable one. The intention is to repeat the festival at intervals of four or five years, thus creating a kind of German Olympics.

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The Prussian Educational Ministry has seen cause to write a strong letter to the Presidents of the bilingual provinces of Sleswick-Holstein, spurring them to greater activity in their attacks upon the Danish language and the Danish sentiment still lingering in the north more especially. The acquisition of the Danish portion of Sleswick at the point of the sword in 1864 has not been an unmixed blessing to the conqueror. Constant friction has been marring every effort at a good understanding, and the teachers in particular have had a very difficult position. Sleswick persists in returning Danes to Parliament, and now that the salaries of teachers throughout Prussia have been protected by the establishment of a minimum, the Danish press, which looks upon them as so many agents for the eradication of Danish sentiment, has successfully prevented the granting of any salary exceeding the minimum prescribed.

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At the same time the Germans are complaining of the neglect of instruction in German, which is manifested in the eastern provinces of Belgium. In the *Deutsche Blätter* it is alleged that the number of illiterates among male Belgians above 21 is 423,000, or more than 25 per cent. Among the girls and women the percentage is said to be over 33. In Luxemburg, where a large proportion of the population speak German—of a kind—it is extremely difficult to get German teachers appointed. The province of Liège, together with Luxemburg, contains about 60,000 monoglot Germans. The German-Belgians demand that a separate department be organised in the Belgian training schools for the training of teachers for the 32 German communes. The demand is supported by the *Soir* among the Brussels papers.

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The school inspector of Saalfeld does not approve of the cycling teacher. This is how he deals with him in his annual report for 1897–98: 'The sport of cycling, too, exerts an objectionable influence upon the younger teachers. Not only do they load themselves with the proportionately high expenses of acquisition, but they are also withheld from wandering in their home districts. Always tied to the road by their wheel, they cannot turn their gaze to the right or to the left, they can neither observe the world of plants nor animals, all home country knowledge remains aside, unnoticed by the cyclist. And that, in my opinion, means a great loss, especially for a teacher, who should incessantly explore the geographical area of his district of influence, so that it should become ever richer and more interesting for himself, and therefore also for his pupils.' I have translated literally, so as to lose none of the charm and force of the original.

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This is what the *Journal des Instituteurs* has to say about 'civic instruction' of the more propagandist kind: What should be taught in the schools are the ideas related to what M. Devinat calls civic instruction. M. Faquet demanded recently that only such things should be taught as are undisputed and indisputable. But this leaves open several questions. Is it the business of our Republican schools to make the pupils understand and love the Republican form of government? In our country of universal suffrage, shall we teach our pupils what national Sovereignty and its true legitimacy mean? Shall we, in history or otherwise, speak of the Principles of 1789 and the Incontrovertible and Inalienable Rights of Man? Shall we speak of the Edict of Nantes, of its Revocation, of the *Coup d'État?* Yes or No? But at the same time it must be understood that we can demand of the public school that from all its lessons and precepts the passion and party spirit of politics and politicians be excluded. That it should cultivate a love of liberty, equality, right, and justice in the political arena, with the same relative serenity as in the purely moral domain, with the same disinterested tone and the same benevolence before all men.' The last clauses sound very conciliatory; but to talk of Republican schools when the ordinary national schools are meant leaves a very disagreeable impression. What if the next generation talks of 'our Bonapartist schools' or 'our Legitimist schools'? The school has too often been made a means of political propaganda, useful for nothing except for raising a sentiment of distrust and disloyalty.

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At the present time, when co-education of the sexes is universally tabooed in France, it is curious to learn that at the time of Charlemagne it was generally in vogue. When Christianity was introduced into Gaul, schools sprang up everywhere. Those of Bordeaux and Clermont were specially famous, and, like Milan, they received both boys and girls. Marcella, Aglasia, Albina, and Hypatia are some of the more illustrious girl graduates of those times. Alcuin instructed not only the sons of Charlemagne, but also his sister Gisela, his daughters Gisela and Richtrudis and their girl friends. From the end of the ninth century the clergy took exclusive charge of the schools, and discouraged co-education. The historian, Walter de Coventia, relates that co-education flourished in Ireland for some time longer, but that one teacher was expelled the country because he applied the tonsure to all his pupils, youths and maidens alike.

OUR CLASS ROOM AIDS

THE PRINCIPLES AND PRACTICE OF CLASS TEACHING.

DECIMALS.

AT whatever stage the teaching of decimals may be introduced, the most natural starting-point is the fundamental principle of our notation—that of the **local value** of the figures. Thus, in 222 only one of the figures has the value of 2. The others mean 2×10 and $2 \times 10 \times 10$ respectively. Each figure is ten times greater than it would be if one place farther to the right, or one-tenth of what it would be one place farther to the left. On the same principle, we may write a series to the right of the units place, using some mark to show which place is counted as units. (The mark used is of course a point placed to its right.) 2·222 will then mean $2 + 2 \times \frac{1}{10} + 2 \times \frac{1}{10} \times \frac{1}{10} + 2 \times \frac{1}{10} \times \frac{1}{10} \times \frac{1}{10}$, or $2 + \frac{2}{10} + \frac{2}{100} + \frac{2}{1000}$.

As soon as the principle of decimal notation has been clearly grasped, a large number of **mental exercises** should be given in **multiplying and dividing decimal fractions by 10 and powers of 10**; the result in each case is merely to **shift the decimal point** one or more places to the right or to the left. This will help to fix the meaning of the point, and will give some facility in dealing with this unfamiliar form of fractional notation. In order still further to ensure that the idea is grasped, a number of **concrete illustrations** should be given, by dealing with sums of money expressed in decimal form. £·5, £·05, ·25s., ·75d., and the like, should be changed mentally from the decimal to the common form, and *vice versa*. Care should be taken to avoid sums that involve recurring decimals at this stage.

In the teaching of the four simple rules applied to decimals, two principles of illustration must be kept in view—(1) **illustration from the decimal system**, or the principle of the local value of figures, which is the basis of our arithmetical notation; and (2) **illustration from vulgar fractions**, whose rules are already known.

The rule for placing decimals preparatory to addition and subtraction should be shown to be the same as in simple addition and subtraction—units, tenths, hundredths, etc., each in its own column, just as units, tens, and hundreds. The addition begins at the lowest denomination, in order to allow of carrying up the tens, as in simple addition. But in order to connect the fractional meaning of decimals with the idea of fractions as already understood in the form of vulgar fractions, the early addition exercises should be performed in *both systems of notation*. The results will be seen to be of the same value in both forms.

The rule for multiplication should also be explained in connection with the notation of vulgar fractions. It does not seem clear at first why ·3 × ·7 should give two decimal places in the answer—·21, instead of 2·1. But if ·3 be written as $\frac{3}{10}$, and ·7 as $\frac{7}{10}$, the answer is seen at once to be $\frac{21}{100}$, or ·21. A few similar examples will enable the pupil to deduce the rule that the number of decimal places in the answer must be the sum of the number of places in both factors. Mixed numbers, reduced to the form of improper fractions, should also be used in these illustrations.

The placing of the point in division of decimals will need more care. The principle must first be thoroughly explained and illustrated that multiplying or dividing *both the divisor and the dividend* by any number does not affect the quotient. This may be shown to be the principle underlying the familiar process of cancelling, as used in former rules. The convenience must next be demonstrated of multiplying both divisor and dividend by such a power of 10 as will *make the divisor a whole number*; then the fractional part of the answer will commence when the integral part of the dividend has been exhausted and the first decimal place has been taken down. A few examples should be *prepared* for division in this way before the actual dividing is performed by the class. Thus 2·5 ÷ ·5 is the same as 25 ÷ 5 (multiplying by 10); 3·125 ÷ ·01 = 312·5 ÷ 1; 5 ÷ ·005 = 5000 ÷ 5, and so on.

The fact that decimal fractions may be expressed in the ordinary or vulgar notation has been already made use of. The converse of this—that all vulgar fractions have an equivalent in decimal form—may be partly explained before the rules now discussed, but its full demonstration involves the use of **repeating decimals**, and on this account it may be left over to a later stage. **Only those vulgar fractions** can be converted into finite decimals **whose numerators have 5 and 2 as their prime factors.** Wherever the other prime numbers occur as factors, 3, 7, 11, 13, etc., the equivalent decimal fraction is a repeating or circulating decimal.

The reason of this is plain, for a decimal fraction is really one whose denomination is some power of 10, and the prime factors of 10 are 2 and 5. If any other prime number enters as a factor into the denominator, and the fraction is in its lowest terms, no amount of manipulation will convert that fraction into one with a power of 10 as its denominator.

The rule for changing a vulgar fraction into decimal form may be simply put thus: 'Perform the division indicated by the position of the two members of the fraction.' $\frac{3}{4}$ means $3 \div 4$; and to express it in a decimal form, we have simply to divide the 3 by the 4, as the horizonal line between them indicates. A more common explanation is to multiply both parts by a number which will make the denominator a power of 10—25 in this case—and re-write the new denominator in decimal form; or to multiply both parts by some power of 10, and divide by the 4. $\frac{3}{4} = \frac{300}{100}$; dividing by 4 we get $\frac{75}{100}$, or ·75. This also illustrates the common rule in a general way.

In dealing with recurring decimals, such as the value of $\frac{1}{3}$, the pupil must first be allowed to carry the division of 1 by 3 far enough to satisfy himself that there is no hope of getting a complete answer in ordinary decimal notation. The need for a new symbol will then be felt; and this symbol must not be supplied until its need has been thus made practically clear.

The method of reducing a given recurring decimal to a vulgar fraction should also be **explained**, and not merely a statement of the rule given. It is impossible, of course, in dealing with such fractions, to explain their nature as the sum of an infinite geometrical series; but an easy arithmetical justification of the rule may be given, and will be appreciated by the pupils.

The pupil already knows that $\frac{1}{3}$ is not $\frac{3}{10}$, but $\frac{3}{10} + \frac{3}{100} + \frac{3}{1000}$ + etc.; and the problem is to express this as a simple vulgar fraction. This plan may be found useful:—

$$\begin{aligned} \dot{3} \times 10 &= 3.\dot{3} \\ \dot{3} \times 1 &= \dot{3} \end{aligned}$$

Subtracting, $\dot{3} \times 9 = 3$; and therefore $\dot{3} = \frac{3}{9}$.

A similar plan will serve for any number of repeating figures, provided the multiplier used is such a power of ten as will make the complete circle a whole number; thus, in the case of ·04̇5—

$$\begin{aligned} \cdot0\dot{4}\dot{5} \times 1000 &= 45.0\dot{4}\dot{5} \\ \cdot0\dot{4}\dot{5} \times 1 &= \cdot0\dot{4}\dot{5} \\ \cdot0\dot{4}\dot{5} \times 999 &= 45 \end{aligned}$$; and therefore $\cdot0\dot{4}\dot{5} = \frac{45}{999}$.

The rule for converting a 'mixed repeater' into a vulgar fraction requires a slight modification. Such a number as ·71645̇ may serve as an illustration.

$$\begin{aligned} \cdot7164\dot{5} \times 100000 &= 71645.0\dot{4}\dot{5} \\ \cdot7164\dot{5} \times 100 &= 71.6\dot{4}\dot{5} \\ \cdot7164\dot{5} \times 99900 &= 71574 \end{aligned}$$; and therefore $\cdot7164\dot{5} = \frac{71574}{99900}$.

Hence comes the ordinary rule—to subtract the finite part from the whole fraction for numerator, and write for denominator a 9 for every repeating figure, and a 0 for each finite figure.

It is essential that clear reasons should be given for these seemingly arbitrary rules, as the pupil is by this time at an age when he should be encouraged to expect a reason for any rule presented to him, and the rules themselves give some scope for useful mental training.

Decimals, and especially repeating decimals, are often handled in a somewhat nerveless fashion in school. Little or no practical use is made of them, and whenever possible the pupils are encouraged to use vulgar fractions rather than decimals. This is a mistake. Many calculations, such as those in compound interest, can be carried through in decimal form with advantage, and the final result alone expressed in the usual form of £ s. d. In a complex fraction, in which both vulgar and decimal fractions occur, and the pupil has the choice of either notation in working out, he should always prefer the decimal, unless there is a certainty of troublesome repeaters occurring.

In working with repeating decimals, children often set about converting them all into vulgar fractions, however simple they may be to manipulate. This is quite unnecessary, and often entails longer processes than keeping to the decimal form. The only case in which reduction to vulgar fractions is advisable is when *both* factors of a multiplication are repeaters, or when a *divisor* is a repeater. Practice should be given in dividing when the dividend repeats, and in multiplying when the multiplicand repeats, keeping to the decimal notation.

OTHER RULES.

The various other rules taught in school do not seem to call for separate treatment, or to involve any new principle. But whatever rule is to be studied, **it must be first of all approached from the practical and common-sense side.** The examples first given should be such as can be solved mentally or by the application of rules already known, and any special method of using these fundamental rules should be then **deduced from the common-sense working out** of actual simple problems.

If the teacher is fortunate enough to have in his own hands the selection of the rules to be studied in his upper classes, his choice should be primarily determined by the question of **what is likely to be most useful** to his pupils in after-life. For a very small minority indeed there may be some use in learning compound interest and discount, with stocks, and the like. Practical exercises in the form of mensuration, according to our own and according to the metric system of measurement, will probably be of more value to the older boys. If the work thus selected for its practical value is taught intelligently, it will secure to the full all the mental discipline which the subject can afford; and to select rules which are valuable *only* for their disciplinary results is, in the common school at least, an educational blunder.

APPROXIMATIONS.

In practical work, it is often of extreme importance to **attain rapidly a result which is approximately correct**; that is, one in which the working is correct so far as it goes, but in which some detail or fractional quantity has been purposely omitted, or expressed in round numbers. This does not usually find any place in elementary text-books, or in examinations in arithmetic. But in ordinary calculations of a practical kind it has a high value. A decimal correct to the second decimal place may be enough; in calculating a price which amounts to thousands of pounds, pence and even shillings may be disregarded; a fractional quantity or a ratio represented by a fraction with three or four figures in each member may be expressed with sufficient accuracy in a fraction with one figure in each; and so on. The intelligence of senior classes may be very profitably exercised in finding out the ways in which calculations can be simplified by the neglect of what is unimportant.

In mental exercises this principle may be freely used, especially in such an exercise as valuing a long decimal fraction of £1. The first decimal place represents florins, being equal to $\frac{1}{10}$ of the unit. The second represents nearly 2½d., being $\frac{1}{100}$ of the unit, and the third nearly ¼d., being $\frac{1}{1000}$ of the unit. Thus ·4583 of £1 is equal to 2s. × 4 + 2½d × 5 + ¼d. × 8 nearly, while the 3 is only $\frac{3}{10}$ of ¼d. nearly, and may be entirely neglected. The answer thus obtained by inspection is 8s. + 1s. 0½d. + 2d., or 9s. 2½d., which is near enough to the correct value for most practical purposes. The rules for finding approximations to larger vulgar fractions, and for contracted multiplication of decimals, should certainly be taught.

CLASS LESSONS IN DOMESTIC ECONOMY.

BY ETHEL R. LUSH.

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STANDARD V.

Lesson XXI.

FOOD: ITS FUNCTIONS AND NUTRITIVE VALUE.

YOU have learnt in an earlier lesson that the general uses to which food is put in the body are those of building up and renewing the tissues, and of giving heat and energy.

I want now to give you some idea as to the special work performed by each class of foods.

You will remember that the body is made up of various kinds of tissues differing widely from each other in structure. It is clear that what will repair and build up one set of tissues will not be at all suitable for another; hence the necessity for a mixed diet, which supplies to each part of the body just what it requires.

It is found that the great class of *Nitrogenous Foods* has for its main function the formation of flesh or muscle. When you eat a piece of lean meat you are taking the muscle of the cow or sheep to build up your own muscle; when you eat an egg, the albumen which was intended to form the body of a chicken goes to form your body instead.

It used to be thought that nitrogenous foods were flesh-formers and nothing more; but now we know that they take part in building up every part of the body. When you take up the study of physiology you will learn that human beings, like animals and plants, are made up of a collection of minute cells containing a nitrogenous substance called protoplasm.

It is easy to understand, therefore, that in supplying the material for protoplasm, nitrogenous foods are building up the whole frame.

Nitrogenous foods are also heat-givers.

In the lesson on the chemistry of food, you learnt that bread and lean meat, and, indeed, all proteids, contain in addition to nitrogen, carbon and hydrogen, which, as you know, are the chief heat-giving elements of food. Remembering this, it is only natural to expect that when nitrogenous foods undergo combustion, heat should be produced as a result. In connection with this point it is significant to notice that most nitrogenous foods contain more carbon and hydrogen than nitrogen; thus bread, a typical proteid, has only 8 per cent. proteid matter to nearly 50 per cent. of carbohydrates.

Among the minor functions of nitrogenous foods it may be noted that they aid in the formation of some of the digestive juices.

Next in importance to the proteids come the *Fats*, whose functions are numerous. When you consider that fats are made up entirely of carbon, hydrogen and oxygen, with very little of the latter, you will understand that they are pre-eminently heat-givers; you have only to drop a piece of fat into the fire and note with what fierceness it burns, to convince yourselves of this.

If a greater quantity of fat is taken into the body than is required for the daily needs, it is stored up as fatty tissue, and in this form serves more that one useful purpose. When you wish to send a breakable or very delicate object from one place to another, you wrap it up in soft coverings to protect it from injury; so, in the body, some of the most delicately-constructed organs are protected by wrappings and cushions of fat. Look at a sheep's kidney as it is taken from the carcase; it appears to be a solid lump of fat until you cut into it and find the organ within. The heart is protected by fatty tissue, and the eye is embedded in fat.

Then, too, this fatty tissue is stored away beneath the skin, where it rounds off sharp corners and gives a pleasing appearance of plumpness, besides helping to keep in the heat of the body.

Further, when an emergency occurs, as in cases of illness or famine, the body draws upon this supply of fat for its daily requirements, just as you might go to the savings bank, if poverty assailed you, and draw out the money you had put by in prosperous times.

The uses of fats do not even end here; for during their passage down the alimentary canal and you will remember that they go the whole length from the mouth to the small intestine—they lubricate its walls, and so, by lessening the friction set up by hard and rough particles, enable the food to slip along more easily.

An illustration of this function of fatty food is furnished by the general use of castor oil to stimulate the excretory action of the intestines.

Then, too, fats aid digestion. In the last lesson you learnt that the emulsification of fats is brought about by the combined action of bile and pancreatic juice.

It seems that the presence of fat in a diet stimulates the flow of these juices, and as the pancreatic juice acts upon other kinds of food besides fats, digestion in general is stimulated. It is partly with this idea that cod-liver oil is given to delicate children whose appetites are small and whose digestions are weak.

Carbohydrates, like fats, are mainly heat-givers. They are made up, as their name implies, of carbon, hydrogen and oxygen, the two latter being in the proportion to form water. If you put a lump of sugar into a small tin dish, and pour over it a drop or two of sulphuric acid, you will find that gradually the sugar diminishes in size and turns black, because the acid is driving away the hydrogen and oxygen and leaving only the carbon behind.

The carbohydrates do not, however, give heat to such a degree as the fats. Roughly speaking, fats give about 2½ times as much heat as an equal quantity of starch and sugar. It is for this reason that starchy foods are so largely used in tropical countries, where heat-giving material is not required to any great extent. In the cold countries of the Polar regions, on the other hand, the natives eat enormous quantities of pure fat.

When an excess of starch and sugar is found in a diet, it is stored up in the body as fatty tissue, and in this form serves the same purposes as fatty tissue formed from a surplus of fatty food.

Mineral Salts, though with the exception of common salt rarely taken alone, are of the utmost importance to the proper formation of certain tissues and juices, and to the preservation of health.

Speaking generally, these salts build up the hard parts of the body, the hair, teeth, bones, and nails; they are necessary to the formation of the blood and digestive juices; and they serve, too, to purify the blood. Common salt, or chloride of sodium, is an indispensable item of diet. Without it, neither the bile nor the gastric juice could be formed, so that this salt, we may say, is necessary to digestion.

We are told that in days of persecution, when terrible tortures were so ingeniously devised, that one plan consisted of supplying the victims with food from which every particle of salt had been extracted, the result being that they soon contracted disease and eventually died in great agony. Whether the story is true or no, the fact remains that an absence of common salt from a diet inevitably leads to disease and death.

Salts of lime, potash and magnesia, especially the first of the three, help in the formation of bone. When a child shows signs of weakness in the bones of the leg, the doctor orders it to take lime-water, with the object of strengthening the bones. Salts of potash and magnesia also enter into the composition of the blood, and to salts of iron the red colouring of the blood is due. You have heard of instances where growing girls, particularly those who do not take much exercise in the open air, have suffered from anæmia, one sign of which is a colourless skin. The lack of the colour which denotes health is due to an absence of iron salts from the blood, and to restore health and strength iron salts in some form or other must be taken.

When we remember that 64 per cent. of the body is made up of water, and that the body loses a large amount daily from the lungs, skin, and kidneys, it is clear that water plays an important part in the body. How necessary it is, is shown by the fact that people die much more quickly from thirst than from hunger. Water is needed to keep the digestive juices in a fluid condition, for without water they could not dissolve the food. Water forms by far the largest proportion of the blood, thus enabling it to flow from one part of the body to another, conveying and distributing nutriment. Further, water serves to remove from the body various waste matters which could not so conveniently be removed in any other way. That the lungs send out a large amount of moisture may be easily proved by breathing on a cold slate and noting the drops of moisture that collect on the surface. The skin sends out various impurities dissolved in water in the form of perspiration, and from the kidneys as much as 50 ozs. of water is excreted daily. Water, too, serves to keep the temperature of the body uniform. In health the heat of the body does not vary owing to the evaporation of perspiration from the surface of the skin.

To prove that evaporation is a cooling process, dip your hands into cold water and let them dry in the air; or, better still, rub a little eau-de-Cologne on your hands and notice how cold they feel as the spirit evaporates.

SUMMARY.

Uses of Nitrogenous Foods:—

1. To form flesh.
2. To enter into cell formation.
3. To give heat.
4. To assist in the formation of digestive juices.

Uses of Fats:—

1. To give heat.
2. To form fatty tissue which { (*a*) acts as a reserve force. (*b*) protects delicate organs.
3. To assist the excretory action of the large intestine.
4. To aid digestion.

Uses of Carbohydrates:—

1. To give heat.
2. To form fatty tissue.

Uses of Mineral Salts:—

1. To form bones, hair, teeth, and nails.
2. To enter into the formation of the blood and digestive juices.
3. To purify the blood.

Uses of Water:—

1. To enter into the formation of all the tissues.
2. To keep the blood and digestive juices in a fluid condition.
3. To aid excretion.
4. To keep the body at an uniform temperature.

A NEW PICTORIAL CHART.

The Birds of the World. (Moffatt and Paige).—This is a large coloured pictorial chart, measuring 60 by 54 inches, varnished and mounted on canvas and rollers. Within a circle of some four feet diameter are figured in their natural colours more than one hundred birds, arranged in groups according to their geographical distribution. There are two rectangular insets in the lower part of the chart. One of these gives an explanation of the six zoo-geographical groups in which the birds are placed, and the other contains an outline map of the world coloured to correspond with the geographical grouping. Since the birds are of carefully chosen types, drawn with extreme accuracy, and coloured in most cases from living specimens, the chart will not only serve to illustrate lessons on the geographical distribution of birds, but will give children clear and correct ideas of the colour, form, and habitat of a multitude of typical birds. Carefully compiled and beautifully printed in colours, this effective and extremely useful chart should form part of the wall decoration of every school in the kingdom.

NOTES OF TWO LESSONS.

By WILLIAM DONE, B.A., *Head Master of Brighton Pupil Teachers' School.*

I.—THE HEN'S EGG.

Articles of Illustration.—The blackboard sketches, two or three hen's eggs, two hard-boiled.

OBSERVATIONS AND EXPERIMENTS.	INFERENCES AND ADDITIONAL INFORMATION.
I. *Shape.* Take an egg and measure it with a tape. Along its greater length it will be about 6½ inches round, along its width it will be about 5 inches. Draw two lines on the blackboard to give such an outline. Compare with outline of a sphere. Take a ball of a size similar to the egg. Place this and the egg near together on the table. Give each a gentle push, and watch their rolling movement.	The hen's egg is not the same distance round in all directions, therefore it is not spherical as a ball should be. It is broader at one end than at the other. Its shape is oval. This gives greater strength to the shell. When it is pushed by the hen for the purpose of turning, it revolves round its narrow end, and does not roll too far, as it might easily do if its shape were that of a sphere.
II. *Parts of an egg.* Break a fresh raw egg in a glass. Call attention to the glaire or white part, the yolk, the brittle shell, and the lining membrane. The yolk becomes flattened out. Prick it and note result. Take a hard-boiled egg and cut it in two along the major axis. Note the position of the parts. Now take another hard-boiled one, and carefully take out the yolk. Observe its shape. Show also that the glaire, colourless in the raw egg, is now white and opaque. It peels off in layers also, something like an onion. Careful observation of the raw egg in the glass will show two whitish kinds of thread, one on each side of the yolk.	The shell of an egg is white, brittle, and porous. Held up to the light it is seen to be translucent. The yolk is yellow and globular in shape. It is surrounded by a colourless, sticky liquid, which becomes white and opaque when boiled. The yolk is enclosed in a thin membrane which, if broken, allows the contents to flow out. The egg-shell itself is lined with a thin transparent tough membrane. The yolk is not in the centre of the white, but being lighter than the white tends to float upwards, so that when the egg is at rest, its position is towards the upper part of the shell. If the egg is turned over it will again take up this position. The two tangled white cords attached to the yolk, called balancers, facilitate this movement of the yolk sack.
III. *How the Chick forms.* Looking carefully we see that one part of the yolk of the raw egg is always uppermost, and on this part is a patch of yellow, lighter in colour than the rest of the yolk.	The young chick begins to form exactly over the pale yellow patch, and so is nearest to the warm body of the hen as she sits upon the egg, and farthest away from the ground, and so we see the purpose of the yolk always taking up the same position when the egg is turned.
IV. *Why the Hen turns the eggs.* Ask who has noticed the hen turning her eggs. Generally speaking, this is done twice a day. Eggs which have not been duly turned will not produce healthy chicks.	If the chick lies for long in its little sack without changing its position, parts of its body tend to adhere to the membrane, and so become deformed, or perhaps it becomes unable to leave the shell at all.
V. *Time to hatch the eggs.*	It takes just about twenty-one days to hatch a hen's egg, when the warmth is suitable and the surroundings of the egg not too dry.

II.—THE RABBIT COMPARED WITH THE HARE.

Articles of Illustration.—A wild rabbit and a tame one, a rabbit's skull, and the blackboard sketches.

OBSERVATIONS.	INFERENCES AND FURTHER INFORMATION.
I. *Adaptation of colour.* Call attention to the colour of the fur of the wild rabbit. It is a dull sandy grey. Contrast with that of tame rabbits. Elicit that the latter are of various colours—white, black, grey, etc.	The colour of the wild rabbit is similar to that of the ground where it lives. It is a case of adaptability to its surroundings. It is thus enabled to shun the observation of its enemies. Tame rabbits do not need this precaution. The fur of the hare is darker and somewhat curly.
II. *The mouth and teeth.* Take the rabbit's skull. Examine the teeth. The front teeth are chisel-shaped and curved. The two in the upper jaw have also a groove down them. Noticing carefully, we find two additional teeth behind these long curved ones, so that there are altogether in front four upper teeth and two lower ones. Observe, also, the space between the front teeth and the back ones, which are grinders. There are six back teeth on each side of the upper jaw and four on each side of the lower jaw. Are there any canine or tearing teeth? Notice the upper lip of the rabbit; it is slit, so that the front teeth project. The roof of the mouth is covered with thick, hard ridges. A hairy patch extends inside the mouth from the front teeth to the back ones. The tongue has a thick skin on its upper surface.	The front teeth are admirably adapted for cutting and gnawing. The substances of which they are composed are of different degrees of hardness, and, as the rabbit gnaws, the inside of the tooth wears down faster than the enamel outside, and so leaves a sloping surface with a fine cutting edge. Show, in further illustration of this, a carpenter's chisel. Furthermore, the rabbit's teeth never stop growing, so that they never get worn out as ours do. The split upper lip is also necessary to the gnawing habit of the animal. From the absence of canine teeth we also infer that the animal does not live on flesh. The hard palate and tongue, with the hairy patch inside the cheek, prevent any splinters from running into the rabbit's flesh when the animal is gnawing. A hare's head is like a rabbit's in this respect.
III. *Their abode.* Some of the children will have seen a rabbit warren, but know that hares do not burrow. The warrens are in more or less sandy districts, and have many openings. The hare scratches up a bed of leaves or grass in the open, or under a tree.	A rabbit is a very timid animal, and burrows in the ground to escape its enemies. The many openings and passages facilitate its escape. The nest is made warm with leaves and grass and pieces of cast-fur. When a rabbit is hunted it flies to its burrow. A hare, if it cannot escape notice by crouching, will run, and trust to its swiftness for safety.

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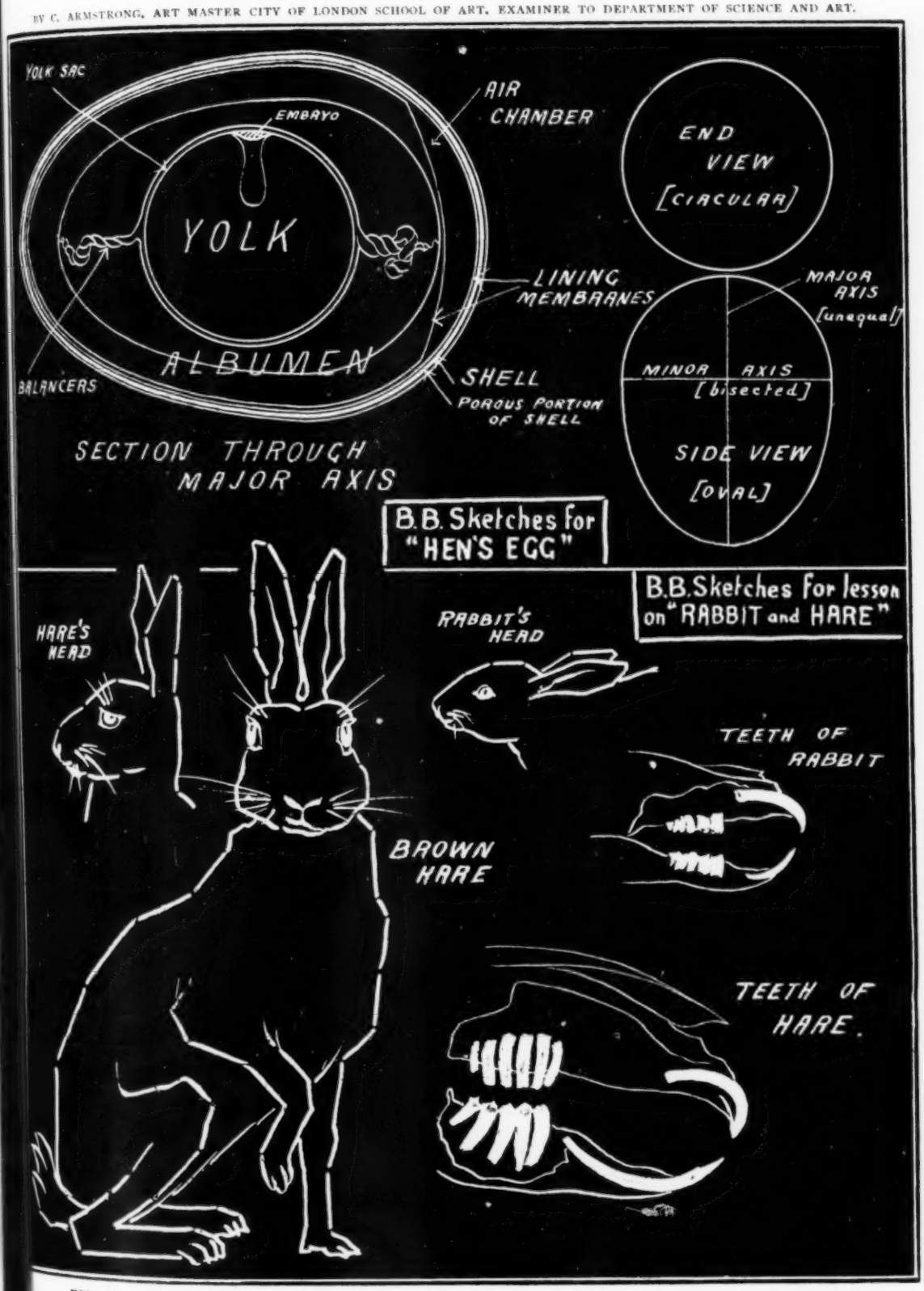
BLACKBOARD ILLUSTRATION.

BY C. ARMSTRONG, ART MASTER CITY OF LONDON SCHOOL OF ART, EXAMINER TO DEPARTMENT OF SCIENCE AND ART.



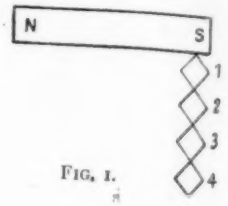
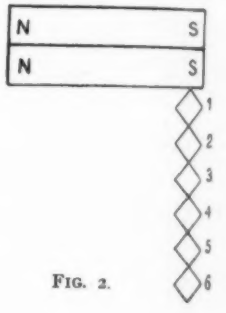
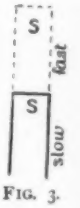
HOW TO TEACH MAGNETISM AND ELECTRICITY
AS A 'SPECIFIC SUBJECT.'

By B. ELDERKIN, *Model School, Westminster Training College.*

First Year's Course.—MAGNETISM—Lesson 8.

ACTION OF MAGNETS IN RE-INFORCING AND WEAKENING ONE ANOTHER.

Apparatus.—Bar Magnets, Stand, and Small Squares of Soft Iron, Magnetic Needle, Drawings of some previous experiments.

Heads and Matter Taught.	Methods of Teaching.	Diagrams as Illustrations.
I. TWO MAGNETS WITH LIKE POLES. *Two magnets with like poles together are stronger than one, but not twice as strong.*	(*a*) Lay one bar magnet on stand; make magnetic chain, as in Lesson VII., as long as possible. (*b*) Count pieces of iron, and number off as in Fig. 1. (*c*) Place second magnet on first (Fig. 2), and ascertain how many pieces may now be supported. It will be seen that the chain cannot be *doubled* in length.	 FIG. 1.
II. FACTS TO BE INFERRED:— 1. The polarity of each piece will be the same with two magnets as with one.	1. This may be questioned out, as no new principle is involved.	
2. The strength of each induced pole in the pieces of soft iron is increased because two magnets are working together and there is greater flux.	2. Also questioned out.	 FIG. 2.
3. The fourth piece in Fig. 2 being more strongly magnetised with two magnets will support additional pieces, but not as many more.	3. Ask why No. 4 piece is now stronger and can support more pieces than with one magnet only.	
III. REASONS FOR THESE PHENOMENA. 1. The action of two like poles is repellant, therefore one magnet *interferes* with the flux of the other.	1. This may be questioned out. The repellant action of two like poles is shown by means of the curves with iron filings, as in Lesson VI., Figs. 10 and 11.	
2. The force of a pole is lessened when it acts at a distance. The upper magnet acts on the soft iron at a distance equal to the *thickness* of the lower one. It cannot do work equal to the lower one.	2. May be shown with magnet and magnetic needle. The vibrations will be quicker and shorter as the magnet is brought nearer the needle. (Fig. 3.)	  FIG. 3.
IV. TWO MAGNETS WITH UNLIKE POLES TOGETHER. *Two unlike poles are weaker than one single pole.* FACTS TO BE INFERRED:— 1. Two like poles produce interference with one another, while two unlike poles *attract* and tend to *neutralise* one another.	Make the chain as in Fig. 1. Now slide the second maguet along the top, as in Fig. 4. Some of the pieces of soft iron will fall off as the poles approach one another. 1. These contrasts must be made as sharply as possible. If two unlike poles attract one another, it is an easy inference that they cannot be free to act on an external body. Hence the pieces fall off.	
2. The two unlike poles of the magnets will tend to reverse the polarity of each piece of soft iron.	2. First show polarity of the pieces when suspended at both ends of magnet (Fig. 5). If these two poles act together on the same set of pieces, the N. pole of one magnet will tend to undo the work of the S. pole of the other, as shown in Fig. 6.	
3. The N. pole at the top cannot quite reverse the inductive action of S. pole because it acts at a distance from the soft iron equal the thickness of lower magnet.	3. Matter may be inferred from experiment (Fig. 4).	

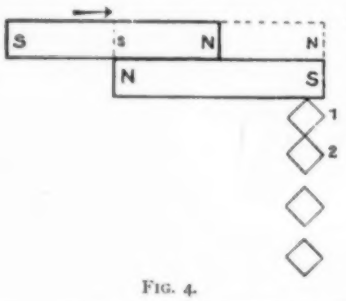


FIG. 4.

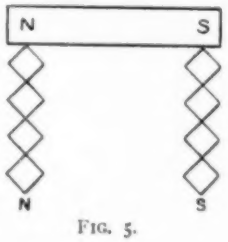


FIG. 5.

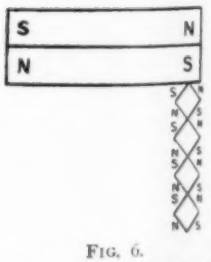


FIG. 6.

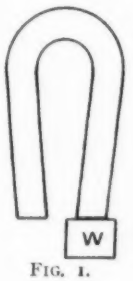
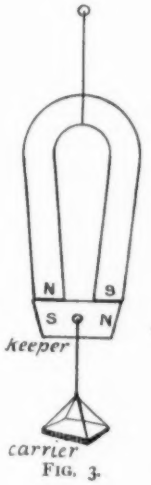
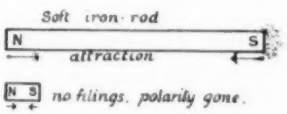
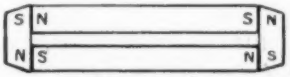
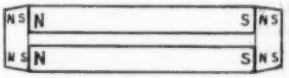
Inductive action by N. pole shown by letters on left.
" " S. " " right.

First Year's Course.

MAGNETISM—Lesson 9.

THE USES OF KEEPERS OR ARMATURE.

Apparatus.—Bar and horseshoe magnets with keepers. A sling or tray made of wood or metal similar to the tray of a pair of scales, supported at the corners with string or wire for carrying the weights. 2 feet of soft iron bar, iron filings.

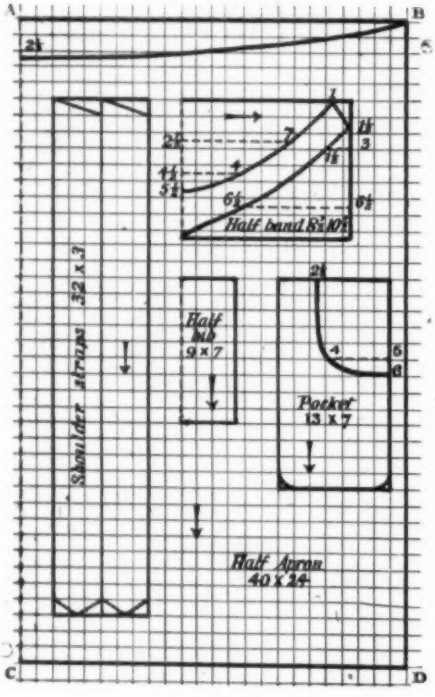
Heads and Matter Taught.	Methods of Teaching.	Diagrams as Illustrations.
I. *The Horseshoe Magnet.* 1. The two poles of a horseshoe magnet in combination will lift more than twice the weight of one of the poles. 2. The lifting power of the horseshoe magnet is greatly increased when the keeper is on. 3. The first use of the keeper is to enable the magnets to support a greater weight.	1. Find the heaviest piece of metal that one pole can lift (Fig. 1). Then that lifted by the two poles combined (Fig. 2). Weigh each. 2. Suspend magnet with keeper on (Fig. 3). A hole should be drilled through it, or a nick filed in the upper edge to support the carrier. Put on the carrier. Put on carrier (*a*) the weight previously supported by one pole, (*b*) the metal carried by 2 poles. It will be seen that more weight can be supported. Pack on any articles at hand till keeper is dragged off. Weigh all the articles including carrier.	 FIG. 1. FIG. 2.
II. *Explanation of phenomena.* 1. The keeper is made of very soft iron. 2. It is easily and powerfully magnetised by induction. 3. It will have two poles of equal strength with those of the magnet, and these *four* poles act in combination.	1. This fact may be ascertained by an attempt to magnetise it by rubbing (See Lesson VII.). 2. Revision of previous knowledge. 3. Polarity of keeper, as shown in Fig. 3.	 FIG. 3.
III.—*Keepers or Armature prevent deterioration of Magnets when not in use.* 1. Magnets have a tendency to loss of strength by the mutual attraction of their poles. 2. The keeper prevents this loss by forcibly pulling the flux of the magnet towards itself, thus keeping the poles strong. 3. The strength of the magnet may be actually re-inforced by this action of the keeper, especially if it be put on slowly and dragged off quickly several times.	1. Take a length of soft iron bar, say 2 feet long. Cut off 2 inches from one end. Rub both pieces with pole of a magnet, and it will be found, if dipped in iron filings, (1) either that long piece is slightly magnetised and short one is not, or (2) that if both are magnetised, the short one will lose its magnetism quicker. These variations will depend on the *softness* of the iron (Fig. 4). The poles attract one another in each case—in the shorter piece more powerfully owing to nearness; therefore demagnetisation results more quickly. 2. Owing to the nearness of the poles of the magnet and keeper respectively. 3. By putting keeper on slowly no backward action is caused; by pulling off quickly there is a tendency to pull polarisation down towards poles.	 FIG. 4.
IV.—*The Bar Magnets.* 1. The keepers are only used for the prevention of deterioration of the magnets when not in use. 2. These magnets deteriorate quicker than horseshoe magnets.	1. The keepers should always be put on, so that re-inforcement of polarity occurs through inductive action on keeper (Fig. 5). If put away, as in Fig. 6, actual weakening occurs. 2. The bending of the horseshoe magnets brings their poles in such a position as to preserve the polarity. In the bar magnets the deterioration is similar to experiment shown in Fig. 4. 3. A strip of wood should be put between the bar magnets to keep them apart.	 Bar Magnets not in use. FIG. 5.  FIG. 6.

NEEDLEWORK FOR PRACTICAL TEACHERS.

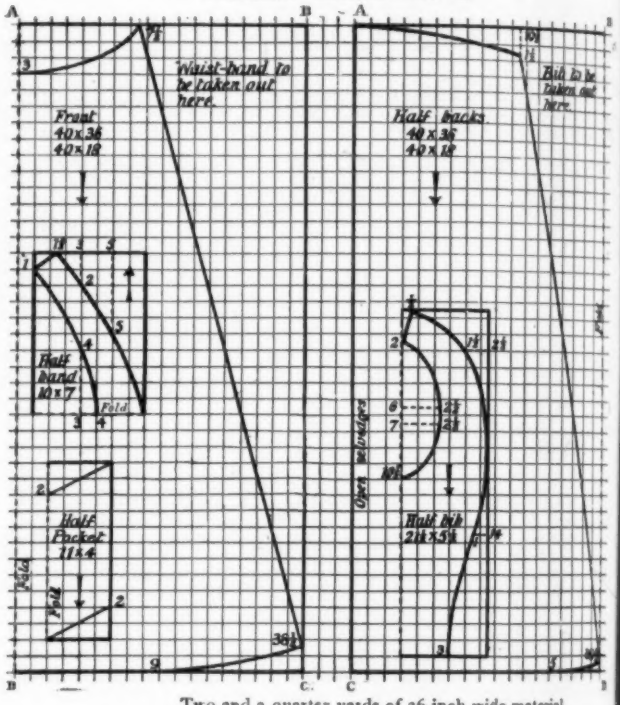
By the Author of 'Blackie's Manual of Needlework.'

WHILE THESE NOTES ARE WRITTEN SPECIALLY TO MEET THE REQUIREMENTS OF CERTIFICATE CANDIDATES, THEY WILL BE FOUND USEFUL BY ALL TEACHERS WHO HAVE TO PREPARE FOR EXAMINATION IN THIS SUBJECT.

COOKING APRON.—No. I.



COOKING APRON.—No. II.


Waist-band to be taken out here.
Front 40 x 36 40 x 18
Half Band 10 x 7
Fold.
Half Pocket 11 x 4
Fold
Bib to be taken out here.
Half back 40 x 36 40 x 18
Open shoulder
Half Bib 21 x 3½

Two and a quarter yards of 36-inch wide material.

FIG. 2. No. I. MADE UP.

DIRECTIONS FOR MAKING UP OF APRON.

(*a*) *Materials.*—The most suitable materials for this apron are dowlas or apron linen, French linen, Galatea, and zephyrs. If an afternoon apron be desired, nainsook, cambric, yosemite, or mull muslin may be used.

(*b*) *Quantity.*—Five yards of *single* material and three yards of *double* width would be necessary for two aprons; this is the most economical plan.

If single material be used, then a width and a half or two widths may be necessary for the skirt, in which case the seam must *not come directly in front*, but to one or both of the sides. When two widths are used, one of them must be cut up the centre, and a half put to each side *to avoid a front seam*.

(*c*) *Seams.*—As the selvedges of the material used for aprons are often unreliable, the selvedges should be torn off, and the seam used for joining would then be a mantua-maker's or French one. These seams were taken up in the November issue of this paper. If the selvedges be even and strong, then join the widths by top-sewing them on the wrong side of the apron.

(*d*) *Skirt.*—Having sloped the top of the skirt so as to fit the pointed band, fold the sides with ¼" hem, and the foot, with one from 1" to 1½" in depth. These must be hemmed neatly. Or the three edges may be finished with a *crossway* band of any contrasting, yet harmonising material. Thus, a Holland apron might have a turkey-red or blue strip of twilled material or plain linen.

(*e*) *Pocket.*—The pocket may have the *curved* edge finished with a narrow stitched hem. The long, short and bottom edges should then be lightly overcast to prevent the edges fraying out, and after a narrow hem has been turned towards the wrong side, these edges should be *stitched* on to the apron.

Or the pocket may be simply hemmed *all round*, and then hemmed on again to the skirt. It *depends* from the waistband at the *right-hand side* as in Fig. 2; but two pockets may be used if preferred.

(*f*) *Waistband.*—A pointed waistband is given above, but a plain one may be substituted if a simpler one is desired. Whether plain or pointed, the band should be *double*, so that the skirt may be inserted between the two edges.

At least two inches more than the waist measure should be allowed for overlapping by button and buttonhole. A full-sized apron requires from 27 to 32 inches.

(*g*) *Insertion of Skirt into Waistband.*—Divide the band into halves, quarters, and eighths. Do the same to the skirt. Leave the part of the skirt *immediately below the bib* (that is about 3 inches) without any fulness. Then pleat up the remaining portion to fit the band, but do so in such a way as to make the greater part of the fulness go to the *last or back* division of the band. The pleats may be folded so as to fall either *towards* or

away from the centre of the front. The skirt may be gathered and attached by setting-in stitches. If pleated, hem or stitch the band on to the apron.

(*h*) *Bib and Shoulder-straps.*—The *foot* of the bib has to be gathered or narrowed with *tiny pleats* so that it shall measure at the foot about $\frac{3}{8}$ *of the width at the top*. The top is finished by a hem from $\frac{3}{4}$ to 1 inch in depth.

The shoulder-straps *having been doubled* are stitched along the *two long edges* of the bib, the stitching or hemming being continued along their whole length.

The bib is inserted between the double edges of the waistband and stitched across.

The bib may be *hemmed all round* and seamed on to the band at the foot, or it may be stitched all round, sewed to the *back* of the waistband, and then finished on the *front* by two rows of stitching.

Having seamed up the *ends* of the shoulder-straps, work a button-hole on the end of each, and sew two buttons to correspond on to the waistband, about 3½ inches from each end. Or *shorter* and *single* straps may be used. These would be attached like a tape to the right and left top edges of the bib.

(*i*) *Sashes.*—If strings are preferred, cut two, each 19″ × 2½″. Round the ends, and having hemmed them all round, attach to each end of waistband.

(*j*) *Ornamentation.*—If of linen, the bib and sash ends may be trimmed with crochet or strong Torchon lace; if of muslin, finer Torchon, frills, or Valenciennes lace may be used.

MENSURATION BY EXPERIMENT.

A SUGGESTIVE LESSON

BY A PRACTICAL TEACHER.

How to find the length of the hypotenuse of a right-angled triangle.

Diagrams to scale—1″ = 6″. Shaded portions are Cardboard.

ANY subject which may be rendered easy of perception by experiment or illustration is not only educationally valuable, but becomes invested with a charm that to the child makes the acquisition of knowledge pleasurable, and to the teacher is decidedly refreshing.

A little consideration will show that of this nature is Mensuration, as outlined in the Code as a specific subject. With suitable training for the reasoning faculty, it offers plenty of scope for educational treatment, and is further of great practical utility to those who shall afterwards engage in carpentry, building, or the allied trades.

Scarcely any teacher who has attempted the subject at all but has by blackboard sketch or paper model made clear the fact that the area of any rectangle, square or oblong, is the same number of square inches as the product of the length and breadth of the figure in inches.

Dividing the rectangle along one diagonal, the half figure is a triangle having the same length of base and the same altitude, whence the area of a right-angled triangle is readily deduced.

Dissection of card-board figures and re-arrangement of parts shows that parallelograms have the same area if their bases be equal and their altitudes the same; and thence that any triangle is equal in area to half the area of the rectangle whose base is the same length and which has the same altitude.

These require comparatively little thought.

Others there are, however, which the teacher who has decided aversion to bare statement of rules, desires equally to illustrate but which offer more serious obstacles. Of such is the relation of the hypotenuse of a right-angled triangle to the length of the sides. To overcome the difficulty and to show this relation clearly and conclusively the following brief notes of an actual and perfectly successful lesson are presented.

The children had already mastered the various processes required in the solution of the problem, *i.e.*, they were well acquainted with the methods of finding the area of a square when a side is given, and the length of a side when the area is given; and with no apparent difficulty they grasped the principles involved.

Case I.—To find the length of the hypotenuse when the sides of the triangle are equal.

Draw on the blackboard an isosceles right-angled triangle ABC (Fig. 1) with equal sides AB. BC, say 6 inches long.

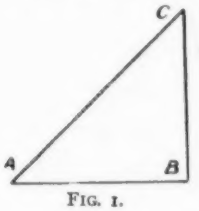


FIG. 1.

Cut out in cardboard two equal squares to fit on AB and BC.

Fasten in position by means of drawing pins, on sides of triangle, to show that they actually are squares on those sides. Questions will elicit that the area of each square is 36 square inches; the area of both together is 72 square inches; and *that however re-arranged, or into whatsoever number of pieces the cardboard be cut, the area remains the same, so long as all the cardboard be used.*

Now cut along the diagonals of the squares as in dotted lines (Fig. 2), making four triangles. Re-arrange these to form a

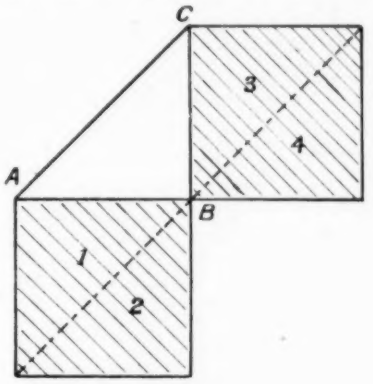


FIG. 2.

square on the hypotenuse AC (Fig. 3). This new figure, the square on the hypotenuse, is of the same area as the two squares

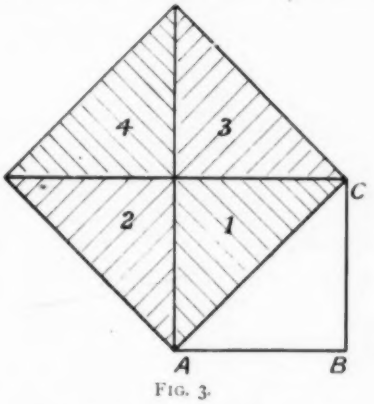


FIG. 3.

on the sides, because formed from them. It therefore equals 72 square inches, whence the length of its side may be readily discovered. But the side of this square is the hypotenuse whose length is required.

Case II.—To find the length of the hypotenuse when the sides of the triangle are unequal.

Draw on the blackboard a right-angled triangle ABC (Fig. 4) with sides AB and BC any length, say 8 inches and 6 inches respectively. Cut out in cardboard two squares, one 6 inches side and the other 8 inches side, to fit on the sides of the triangle. Pin on the B.B. as before.

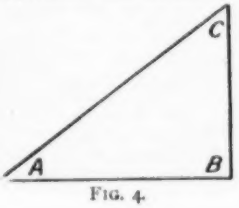


FIG. 4.

Cut out further a figure ABCDE (Fig. 5), which shall be equal to these squares combined. Prove their equality by superposition.

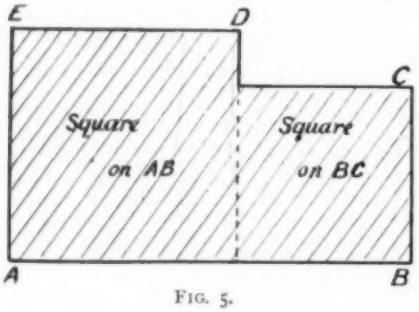


FIG. 5.

The area of the combined squares is 100 square inche (36 sq. in + 64 sq. in.), and however cut and re-arranged tha area is unaltered.

On cardboard figure ABCDE, along the side AB, mark a distance AX equal to the length of the side of the smaller

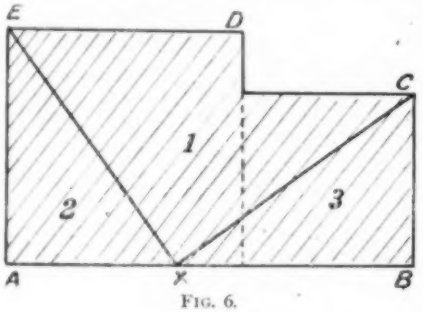


FIG. 6.

square, 6 inches. Join XC and XE (Fig. 6). Cut along these lines and re-arrange the pieces, as in Fig. 7.

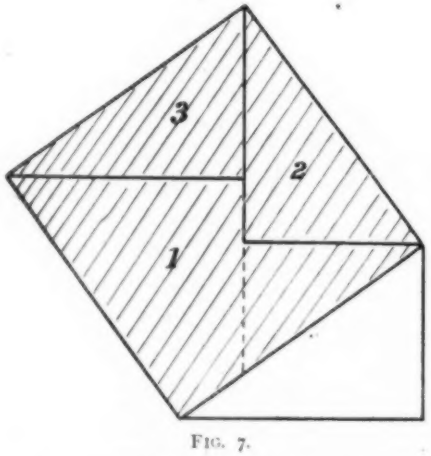


FIG. 7.

The new figure is a square, which may be pinned on the hypotenuse of the right-angled triangle drawn on the blackboard.

Its area we previously found to be 100 square inches, whence its side is 10 inches. But this side is the same length as the hypotenuse, which is therefore also 10 inches.

Questions upon what has been done in both cases will establish the fact, that in any right-angled triangle the sum of the squares on the sides is equal to the square on the hypotenuse, and from that the rule, *i.e.*, *Find the sum of the squares on the sides. Extract the square root of the answer.*

THE INSPECTOR'S NOTE-BOOK.

BY AN INSPECTOR OF SCHOOLS.

Fixed grants bound to come soon. BEFORE long, very probably, we shall have fixed grants. The present system, with its numerous variable grants, makes an Inspector's work under Art. 84 (*b*) very complicated. Writing on this subject, H.M.I. Mr. Milman puts the matter very thoroughly:—

'In that time (two hours) we have to assess the principal grant (which involves testing all the elementary subjects), assess the discipline and organisation grant, assess the grants for two class subjects and for note-singing, hear recitation, decide whether any grant is to be paid for needlework or not, see to the physical exercises, assess the various grants for the infant class, confer with the managers as well as with the head teachers, ascertain whether the children are trained to acquire knowledge for themselves, observe how school is opened, enquire into its general organisation, examine the syllabus of instruction and the record of work, examine the registers and log-book, carefully examine the time-table, see exercise and note-books and marked examination papers, enquire into the attendance of the scholars, perhaps hear an assistant or some pupil teachers read and recite, and besides look at the premises, furniture, and apparatus, and note any defects.'

This is a formidable list of duties, and, of course, only a part of them can be got through in 120 minutes. And so it becomes a question as to which must be attended to and which omitted. A definite general grant would relieve an Inspector considerably, and allow him more time for rendering assistance to the school. Interruption of the time-table to any great extent often disturbs the equilibrium of a school.

Syllabuses, records, etc., at a premium. I venture to place before my readers an interpretation of the new inspection by H.M.I. Mr. Tremenheere. It entirely agrees with my own views, and, indeed, I recommend teachers to endeavour to carry out the ideas therein expressed. Great stress is put upon time-tables and syllabuses of instruction:—'Speaking roughly, the new system seems to me to mean that if a school is conducted in a regular, business-like manner, with a well-arranged time-table and a carefully thought-out plan of instruction in each subject, and if the lessons are given with spirit and on intelligent methods, then "results" may, so far as the inspector is concerned, be safely allowed to take care of themselves. Therefore I pay great attention to the time-tables, and spare no time in assisting the teacher to improve them. The methods and spirit of the lessons we have ample opportunity of observing at our visits; and during the subsequent conferences we are able to make suggestions which are most willingly received. But in order to estimate the treatment of a subject as distinct from that of a single lesson, we must depend upon the syllabus; and in order to judge of the regularity and care with which the daily routine is carried on, and to appreciate the degree of supervision over class progress and individual progress that has been maintained, we must have the records to refer to. Without these precautions, much hollow, unsound work might easily be masked by a few smart lessons.'

The syllabuses of instruction and records of progress are elaborately kept by some teachers and perfunctorily kept by others.

Brief notes of the chief oral lessons should be kept to be shown to an Inspector. Those teachers who neglect the syllabuses and records are, by so doing, laying themselves open to serious criticism under the head of organisation. In the infant schools one does not look for such elaborate syllabuses as in the upper schools. Brief notes showing how the oral lessons are treated should, however, be kept.

For intending Queen's Scholars. In view of the Queen's Scholarship Examination due this month, I here reproduce a few of the most vital criticisms culled from the Blue Book just issued.

Theory of Teaching—'Knowledge of the subject to be taught should be the principal thing shown in these notes, and then skilful adaptation and management.'

The defects in the Notes of Lessons were :—'Lack of definiteness of aim; too much is attempted; bad arrangement; introduction of irrelevant matter; bad methods, *i.e.* telling children instead of leading them to observe, compare, and reason.'

English Language—'Most of the answers showed little power of arrangement.' 'It would seem as if, in the English studies of the pupil teachers, so much attention is directed to parsing and analysis and compilation of lists, affixes, etc., that a question which does not admit of the columnar method of answering, but demands a little straightforward English composition, perplexes the candidate, who offers instead an ill-considered mass of disjointed and ungrammatical notes and phrases.' One Inspector complains of the difficulty of deciphering the answers of those who write an exaggerated form of handwriting in which the strokes forming each letter are very close together.

A knowledge of the requirements of the Code in English for each standard is necessary.

Geography.—'Few of the Geography works used seem "up to date" with regard to Canada. The average mark for the map is nearly always low.'

History.—'It is worthy of note that some candidates, who are otherwise well up in their subject, seem to be unable to remember a single date. The questions that appeal to the memory have, of course, been better answered than those which appeal to the understanding. Speaking generally, it may be said that the papers would have been more satisfactory had the candidates been more proficient at English Composition. Composition, in the larger sense of the word—the power of subordinating the different parts of an answer to a central conception, and so combining them into a harmonious whole—is a weak point in all but the very best papers.'

Euclid.—'The second book was often better known than the first.'

French.—'A disappointingly large number of candidates gained absolutely no marks at all, or only very few—these have received no efficient teaching in French at all, and the time devoted by them to the subject was wasted. The passage of unseen prose was seldom satisfactorily translated. This result tends to show that the general object of pupil teachers is to prepare a set book for examination, not to acquire real, useful knowledge of the French language.'

Dictation.—'Spelling is decidedly good, 1,007 papers showing, on the average, only 1·4 errors per paper.'

Evening School Code, Article 8. In the night schools many teachers are finding Art. 8 difficult to interpret this year: 'No scholar may be entered or continue on the register who is under fourteen years of age, unless such scholar is exempt from the legal obligation to attend school. Evidence of such exemption must be produced to the Inspector before the end of the school year.'

Comparing this article with the same article in last year's Code, it appears pretty plain that, generally speaking, it is intended to exclude the day scholar from the night school. What about the scholars who, although in attendance at a day school, yet have qualified for and obtained Labour Certificates, entitling them, under bye-laws, to total exemption? These certainly are eligible for admission, irrespective of age, and the evidence for the Inspector is the Labour Certificate issued by the local authority. Then there are scholars attending school half time under the Factory Acts. These, it seems to me, are not eligible for admission to night schools, even though they may have passed the full-time standard under the bye-laws; for inasmuch as they are working in a factory, they are not 'exempt from legal obligation to attend school.' I advise teachers to keep the names of doubtful scholars on a separate register.

Answers to Correspondents.

B.C.—Undergraduate University Examinations are not accepted in lieu of parts of the Certificate Examinations except in the case of students in training. If you think you could obtain a degree I should advise you to do so; you could then easily obtain the teacher's certificate.

R.H.F.—Drawing is *not* compulsory for girls. It was so stated in error. As a matter of fact, Drawing cannot be taken by girls unless Cookery is taught.

C.—It all depends what kind of a sacrifice you are prepared to make to gain a Cookery Diploma. Of course the Central Training School is one of the best. For information apply to Mrs. Chas. Clarke, National School of Cookery, Buckingham Palace Road, London, S.W. There are about 40 other institutions which grant diplomas recognised by the Education Department. For addresses of correspondents see page 268, N.U.T. Code.

F.—The B.Litt. degree is granted to women by the University of Durham, but I believe only on residence. For information on the subject apply to the Registrar of the University of Durham. Would not the L.L.A. of St. Andrews suit you better? This is granted to non-residents, and is a well-thought-of degree. If you want further information concerning the B.Litt. write to me again.

M.J.E.—You will be ineligible to sit again to raise your certificate until 1900, as you must miss one year after your second trial. In 1900 you may take Part II. only.

E.L.O.—I am not sure that you can sit for the Scripture Examination; your name should have been sent in by Sept. 30th. Write for a syllabus to the Secretary, National Society, Westminster, London, or to the Secretary, Whitelands Training College, Chelsea, London. At the same time, ask if you can sit for the examination; then send me the syllabus and I will advise you as to books.

S.U.S.—I am sorry to be unable to give you any information *re* Bank of England Clerkships. Write to Clark or Skerry, Chancery Lane, London.

Correspondence intended for this column should be addressed—Inspector, c/o the Editor, 33, Paternoster Row, London.

ELEMENTARY LESSONS IN THE PRINCIPLES OF GRAMMAR.

BY JOHN R. TIMSON, B.A.
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INTRODUCTORY.

THESE lessons were written for junior teachers as notes of oral lessons to Standard IV., children about ten years of age. They comprise the work of the school year of forty weeks, and they have been given week by week to large classes. The amount of matter in each is just what could be practically taught, grasped, and remembered. A second lesson was given each week for revision and for writing exercises.

The method of the oral teaching is here and there indicated. The main principle is to treat the children as speakers, and to practice them in speaking correctly by requiring them to answer in full sentences, and to supply all the examples for exercises. Thus Lesson II. commences with the question :—

'What do you see in the school?'

The reply, 'maps,' should not be accepted, but the full answer, 'I see maps,' must be required. The greater part of all the lessons can be elicited from the children by questioning. The teacher finally gives terms and definitions. The directions given to the pupils refer to the teacher when giving oral lessons to Standard IV.

The field of grammar is thorny and intricate. It is the battlefield of contending philosophers. Differences of opinion are, as a rule, out of place in the schoolroom. The teacher finds it necessary to take a straight course, and to state dogmatically, in a way that children can understand, the views which he holds to be right, and which he feels able to defend. For this reason I have been debarred from giving the arguments which lead to some of the statements laid down.

I can only hope that others may find the lessons as useful in their schools as I have found them to be in my school of over five hundred pupils.

LANGUAGE AND GRAMMAR.

Language is a means of conveying information from one person to another. A speaker enfolds his knowledge in language. The hearer receives the language, and from it obtains the knowledge it represents.

Language is thus a vehicle for the interchange of knowledge.

Plato says that 'Language is a stream of thought passing through the mouth.' The speaker puts thoughts into words. The hearer obtains thoughts from words. These two processes are distinct.

Using the word 'thing,' to mean anything or any thought that can be spoken about, we may state the two processes as

(1) Things to Words, { that is, putting knowledge into language;

(2) Words to Things, { that is, from language obtaining knowledge.

The first process is the building up or synthesis of language by a speaker, the second is the taking to pieces or analysis of language by a hearer.

When both speaker and hearer use and understand the language in one and the same way, the information is rightly conveyed without being altered either by addition or by loss.

To secure correct language as a medium for interchange of thought, the uniformities in its use by educated men are taken as a standard of correct speech. Grammar is the science of the correct use of language.

The first part of grammar is the correct synthesis, composition or building up of language to express things or thoughts. It is the work of a speaker or a writer.

The second part of grammar is the correct analysis, reduction or breaking up of language in order to extract the exact things or thoughts enclosed. It is the work of a hearer or a reader.

This course of lessons deals only with the first view of language, namely, from "Things to Words."

Plato says that he who commences with words and seeks for things will certainly be mistaken, and many great thinkers have said the same.

We must then first study things and the classes of things. Things are named by words, and the classes of things give rise to classes of words.

The use of words to indicate things is the work of the speaker. The speaker must adapt or fit his words to things when he declares or states what he knows. We have therefore to study how he makes an assertion of his knowledge.

Our course involves the consideration of three distinct things :—

1. Things and the classes of things.
2. Corresponding words and classes of words.
3. The assertion of the knowledge of the speaker.

The blurring together of things and words constitutes the greatest pitfall in the study of grammar. At every stage we must clearly determine whether we are dealing with the word alone or with the thing itself which is represented by the word.

LESSON I.

QUESTIONS AND ANSWERS.

Language or speech consists of sounds or signs used to convey information from one person to another. The sounds are spoken and the signs are written.

The person who conveys the knowledge is a speaker or a writer.

The person who receives language is either a hearer or a reader.

For simplicity, we will say :—

The first person is the speaker.

The second person is the hearer.

Every speaker calls himself 'I' or 'me,' *e.g.*, I like cherries; the man gave *me* some.

A speaker calls the hearer 'you.'

Let us suppose the speaker asking a question; *e.g.*,

'Do *you* hear *me*?'

The correct answer is,—

'Yes, *I* hear *you*.'

When the hearer gives an answer and thus becomes the speaker himself, he alters 'you' in the question to 'I' in the answer, and 'I' or 'me' in the question to 'you' in the answer.

'I' and 'me' are the names of any speaker, and 'you' is the name of any hearer.

A man who is neither speaker nor hearer may be called 'he' or 'him,' *e.g.*, *He* is the man; I saw *him*.

We use 'she' and 'her' for a woman who is neither speaker nor hearer.

For a thing we use the word 'it.' The words 'I, thou, he, him, she, her, it,' are the first names for everybody and everything. These words are called pronouns, and they simply distinguish between the speaker, the hearer, and all besides. This distinction is called person.

The first person is the speaker.

The second person is the hearer.

Anyone that is neither speaker nor hearer is called the third person.

The third person is often said to be the person spoken about, but this is not quite correct, for a speaker may speak about himself or about the hearer.

We will now notice how the pronouns change when the speaker is changed. Let us suppose three persons, a man, a boy and a girl speaking in turns to each other, and making one and the same statement. The statement shall be that 'The man saw the boy strike the girl.'

If you were asked how they would make this statement to each other in turns you would give the following replies :—

The man would say :

(1.) To the boy. 'I saw you strike her.'
(2.) To the girl. 'I „ him „ you.'

The boy would say :

(1.) To the man. 'You „ me „ her.'
(2.) To the girl. 'He „ me „ you.'

The girl would say :

(1.) To the man. 'You „ him „ me.'
(2.) To the boy. 'He „ you „ me.'

From this we see that the man is named 'I,' 'you' and 'he' in turns according as he is the speaker, the hearer, or neither speaker nor hearer.

Similarly the words used for the boy and the girl change or vary. For this reason pronouns are sometimes called 'variable names.'

The practice of answering questions by full answers brings out most clearly the use of pronouns. In giving an answer in full we must repeat as far as possible the words of the question, being very careful to change the pronouns.

Question : Can *I* help *you*?

Answer : Yes, *you* can help *me*.

The speaker of the question is the hearer of the answer. For this reason 'I' is changed to 'you.'

The words 'do' and 'did,' when used to ask questions, must be left out in the answer; *e.g.*,

Did you see me?
Yes, I saw you.

But if the answer is 'no,' then the words 'do' and 'did' must be kept :

No, I did not see you.

MEMORY NOTES.

A pronoun is a word that may be used as a name for everything that speaks, is spoken to, or is spoken about.

Personal pronouns distinguish between,

(1.) The speaker.
(2.) The hearer.
(3.) Other persons and things.

Pronouns are the first names for everything.

The speaker calls himself 'I,' the hearer 'you,' and other ones he calls 'he,' 'she' or 'it.'

The following pronouns should be committed to memory in order :—

I, thou, he, we, you, they.

OUR TUTORIAL SECTION

OUR PUPIL TEACHERS' AND SCHOLARSHIP COURSE.

BY ARTHUR T. FLUX,

Head Master of the Belvedere Pupil Teachers' Centre, First on Scholarship List, Author of 'Scholarship School Management.'

SPRING EXAMINATION, 1899.

NINTH MONTH—DECEMBER.

WORK TO BE PREPARED.

A.—*English.*

First Year.—'Ode on Spring,' verses 3 and 4.

Second Year.—Prepare fully lines 287–340 'The Deserted Village.'

Third Year.—1. Learn 20 roots and meanings per week.
2. Prepare lines 280–325, Pope's 'Essay on Man.' Epis. IV.

Notes—(a) '*Ode on Spring.*'

Line 23. *Yet* = Adversative Conjunction.
hark = Principal verb followed by Noun Sentence.
how = Conj. Subord. joining principal with Noun Sentence.
26 and 27. These lines depends on *youth* in 25.
to task = Infinitive limiting *eager*.
to float = " " "
30. This line is an enlargement of *some* in 29.
31. An extension of the Predicate in next line.
32. *Such* = Adj. Qual. qualifying *race* predicatively.
34. *Where they began* = Adv. of Place to *shall end*.
35. *Alike* = Adv. of Manner mod. *flutter*.
36. *But* = " Degree " "
37. An enlargement of *busy* and *gay*.
38. *Brushed . . . . age* = Participial enlargements of *they*.
49. *To rest in dust* = Infinitive Phrase of purpose.

General Paraphrase.

Under the increased heat of the noon-day, man relaxes for a time his laborious work, and even the animals rest in the welcome shade; but the insects are busier than ever. Awakened to life by the genial warmth, they are to be seen everywhere, some hovering over the opening flowers, some glancing over the water, and others circling through the air and showing as the sunlight falls on them the brilliancy of their colouring.

To the philosopher there is a striking analogy between their apparently aimless and transient existence and that of the whole human race. Whether humble like the creeping insects, or ambitious like those that dash through the air, their exertions lead them all to the same end. People pass through their brief existence, some busy and hard working, others gay and frivolous, with no serious thoughts on the end awaiting them. Every degree of Fortune is exhibited, from the indigence of the poor to the luxury of the extremely rich. Yet a common fate awaits them. Whether they are suddenly carried off by some accident, or whether they linger on till old age, sooner or later they return to the dust from which they sprang.

Last Stanza of 'The Bard.'

Line 125. *Truth, Love, and War* = Subjects of *adorn*.
again = Adv. of Repetition mod. *adorn*.
127. *Drest by fairy Fiction* = Participial Enlargement of the three Subjects.
129. *Grief and Pain* = Subjects of *move*.
(Note the personification in these lines.)
132. *Gales* = Subject. of *bear*. *Voice* = Object.
133. *As* = Adverbial Conjunction followed by Elliptical Sentence.
134. Adj. Sentence to *warblings*.
last in long futurity = Participial Enlargement of *that*.
135. *You . . . . day* = Noun Sentence Object. of *Thinkest*.
Raised by thy breath = Participial Enlargement of *cloud*.
137. *To-morrow* = Adv. of *Time*.
139. Supply *It is* enough for me. *Enough* = Adj. qual. *it*.
140. *Our Fates assign* = Adj. sent. to *doom*.
141. *Be* = Imperative Mood. Subject = *Despair and Care*.
142. *To triumph and to die* = Gerundial Infinitive subjects of *are*.
mine = Poss. Pro. Nom. case after *are*.
143. *Headlong* = Adv. of Manner mod. *plunged*.

The first part of this stanza refers to the Elizabethan Dramatists. The Bard implies that poetry would be dead from the time of the Massacre of the Bards till the coming of the Tudor line (also Welsh). Lines 135 *et seq.* may be freely rendered, 'Do you think that because you have slain the Bards you have quenched the flow of poetry? You have not, any more than a passing cloud puts out the sun. It soon passes, and the light and life are redoubled.')

'The Deserted Village.' General Paraphrase (cont.).

Line 267.—As a woman in the first flush of youth and beauty relies entirely upon her natural charms for attraction, and despises the artificial appearance of cosmetics produced by fashion, powder, and paint; but when her beauty begins to pass away, as it will, seeks to replace it by those means which only accentuate the ravages of time they are supposed to hide; so a land when vigorous and strong is void of all appearance of splendour, and it is only when a healthy life is beginning to fade, and when the real stamina of the people is decaying, that an attempt is made to disguise this decay by garish splendour of dress and architecture. In proportion as these outward signs of prosperity increase, the condition, poverty, and misery of the poor degenerates, and the whole country is like a grave, covered with flowers outside and full of corruption within.

303.—In fact no place is left for the thrifty peasant. He is crowded out of his village home to allow of the erection of a mansion, and if, still struggling for an existence, he drives the remnant of his flock to the common, he too frequently finds that that has been fenced in by some grasping landowner, and the rights of pasturage on the common land, handed down from earliest times, are stolen from him.

309.—And what is his fate if he repairs to some town? There he merely sees the ostentation of luxury and plenty, in which he cannot participate. He sees innumerable methods by which wealth is dissipated at the expense of the vigour of the race, and he is bound to recognise that each device for pandering to the jaded and luxurious tastes of the few is an additional misery inflicted upon the poor. The contrasts are too striking to be unnoticed. While the courtier lounges along dressed in the most costly apparel, the poor artist, devoting his life to ideas of beauty, yet half starved, works in a bare garret; while in one place there is a gathering of men and women each bent on outdoing the others in pride and empty show, a short distance away, hanging from the gallows, is a ghastly array of felons, whose crimes and death were caused by the misery of poverty and starvation.

Or watch some fashionable gathering at a mansion or place of entertainment. As the gaudy chariots rattle up and disgorge their more gaudy occupants, decked in costly robes and bedizened with jewels, the glare of the torches, the continual excitement, the appearance of lavish wealth, the splendour exhibited on all sides, might warrant an observer in coming to the conclusion that the land surely must be in a most flourishing condition, and that poverty and wretchedness are entirely unknown. Yet one has but to turn his eyes in a different direction to see a striking contrast. On the doorstep of some house lies a wretched woman, clad in rags, gaunt from starvation and illness, destitute even of the means to procure a less inhospitable shelter for the night. Once in her village home she was a pure sweet girl, who wept with pity at the tales occasionally told of troubles and suffering. Like some wild flower her beauty and innocence added a charm to the rural scene in which she lived. What a contrast! Now her friends are all lost, her virtue is gone. Trusting to the lying words of some admirer, she left her humble and peaceful occupation to don the garb of fashion and see the vicious splendour of the town, and now thrown aside like a used toy, shivering in the pelting rain, she remembers with infinite and useless regret her former happy life at home.

Notes on Parsing and Analysis, etc.

Line 287. *As* = Adv. Conj. joined Adv. Sentence to the Principal, 'Thus fares, etc.'
288. *Secure* = Adj. qual. *female*. *To please* Infinitive limiting *secure*.
while . . . . reign = Adv. Sentence to *please*.
291. *But* = Adversative Conj. joining preceding with *She then shines forth*.
For = Illative Conj.
292. Adverbial Sentences to *next*.
293. *Solicitous* = Adj. qual. *she*.
to bless = Infinitive limiting *solicitous*. (A very common construction in the poem.)
295. *Betrayed by luxury* = Participial Enlargement of *land*.
296. *At first* = Adv. Phrase of *Time*.
297. *verging to decline* = Participial Enlargement of *its*.
299. *Scourged by Famine, &c.* = Participial Enlargement of *peasant*.
301. *Without . . . . save* = Adv. extension of *sinks*.
to save = Infinitive qual. *arm*.
302. *Garden and grave* in apposition with *country*.
303. *Where* = Interrogative Adverb.
304. *To scape* = Infin. of Purpose mod. *reside*.
305. *To some . . . . strayed* = Participial Enlargement of *he*.
306. *To pick* = Infin. of Purpose mod. *drives*.
308. *Even* = Adj. of Emphasis to *common*.
309. *If . . . . shed* = Participial Enlargement of *him*.
What = Interrogative Pronoun.
310–314. *that he must not share* = Adj. Sent. to *profusion*.
that the sons of pleasure know = Adj. Sent. to *joys*.
All the rest is the subject of *awaits him* understood. *To see* Gerundial Infinitive, subject of *awaits* him.
317. *To pamper* and *to thin* = Infinitive of Purpose mod. *combined*.
combined and *extorted* are participles, *not* predicates.
320. *Sure* = *surely*.
scenes = Object. gov. by *annoy*.
like = Adj. qual. *scenes* and gov. *these* in Obj. Case.
these = Demonstrative Pro. Obj. gov. by *like*.
327. *Once* = Adv. of Time mod. *he wept*.
perhaps = Adv. of Doubt, mod. *has wept*.
330. *Sweet* = Adj. qual. *looks*.
'as . . . . thorn' = Adv. Sentence Degree mod. *sweet*.
331. Supply *she is*.
Friends and *virtue* = Nominatives Absolute.
335. *When she left. &c.* = Adj. to *Hour*.

'Essay on Man.' General Paraphrase (cont.).

Line 280.—Are you imbued with the idea that you would enjoy pure happiness if you possessed a mere powerful mind than your fellows? Look at Bacon, a man whose mind was stored with accumulated wisdom, who was the most brilliant scholar of his times, and yet stooped to such mean contemptible actions as would disgrace anyone. Are you desirous of fame? Then think of Cromwell, who is remembered certainly, but whose memory only calls forth a curse. In fact, any of the attributes which are usually associated with and constitute a great man in the eyes of the world are coupled with some striking disgrace. History affords innumerable cases. The favourites of kings were ever ready to ruin them, the friends of queens to betray them. These great and famous men in popular opinion spring generally from the lowest rank of life and had their origin, like Venice, in mud and slime. As the hero mounts the ladder of fame he deteriorates in moral status and his greatest victories are stained with unnecessary bloodshed or polluted by the acceptance of base bribes. They may have inherited wealth, or accumulated it perhaps by brutal tyranny over some defenceless people, the taint of disgrace is inevitably to be found. And when the time comes for them to finish their earthly career, though surrounded by every luxury that wealth can devise, they have no peace or happiness. Be not then carried away by the empty pomp of their fame. Examine

their lives from beginning to end, estimate the real happiness they felt and the miseries they had to undergo, and you can but come to the conclusion that the greater is a man's fame the greater is the shame which accrues to him.

Line 309.—From these considerations we are compelled to accept the truth of the statement—the only true happiness which man can experience is that derived from the consciousness of virtue! It is the only case in which happiness is felt without an attendant pain, in which real merit is rewarded, some good aim or purpose is attained. The joy resulting therefrom is unmitigated pleasure and if failure is the result no pain is experienced, for there is the consciousness of virtuous effort. The greater the trials and troubles a man passes through the keener is his sense of happiness, and even when in tears he is often more truly happy than a fool who exhibits boisterous mirth and laughter. Additional pleasure is derived from everything and everywhere. A good man is never truly happy and satisfied while he sees anyone in trouble, neither is he dejected and envious because he sees others with more blessings than himself. With such a man there are no vain wants or wishes, for his only wish is to become a better man, and the very fact that he wishes this is sufficient to produce the desired result.

Notes.

(Lines 285–308 were originally intended to apply to Marlborough, but were afterwards altered so as to apply to any case. Line 286 was originally 'In *one man's* fortune, mark and scorn them all.' But the passage still contains pointed allusions to Marlborough, his ambition (285), his desertion of James II. (290), his victories (295), his avarice (296 and 298), imperious wife (302), etc.).

Line 283. Read, If you are ravished, etc. *whistling* = a gerund.
285. *All* = subject; *ambition* = object.
286. *to scorn* = Gerundial Infinitive gov. by *learn*.
288. *Complete* = Adj. qual. *scale*.
289–90. Read, How happy there were to ruin—who lay in hearts of kings, or how happy there were to betray—who lay in arms of queens.
292. *As . . . rose* = Adv. Sentence of Manner to *grows*.
293–4. Noun Sentences gov. by *Mark*.
297. *Broke* = *Broken*, participle qual. *them*.
299. *wealth* = Nominative of Exclamation.
305. *Not . . . . way* = Participial Clause qual. *you* understood.
308. *Tale* in apposition with *fame*.
309. *Enough . . . know* = Phrase enlarging *truth*. *To know*, Infin. mod. *enough*.
310. *Alone* = (Lat. Solus). Adj. qual. *Virtue*.
Below = Adv. mod. Predicate.
314. *in* = Prepos. gov. *what it takes—what it gives*.
315. Supply *is*.
316. *lose* = Subjunctive Mood. Read *It is attended*, etc.
317-318. Supply *it is*.
317. *E'er*. Adv. of Emphasis mod. *so*.
318. *But* = *only* = Adv. mod. *more relished*.
320. *Far* = Adv. of Degree mod. *less*. *Than* = Comp. Conj. Read. Than Virtue's tears are pleasing. *Very* = Adj. of Emphasis to *tears*.
320-24. Supply *is* where necessary.
326. *But* = only = Adv. of degree mod. *to wish*. *To wish . . . . to gain*. Grundial Infinitives. Nominative to and after *is*.

B.—*Arithmetic.*

Boys and Girls.—All years.—Continue general practice.

Model Solutions to some of the Sums set in October P.T. Exam. 1898.

1. A man loses $\frac{1}{3}$ of his fortune. He then speculates with $\frac{1}{3}$ of what he has left and loses $\frac{1}{4}$ of the sum with which he speculated. He then has £2,800 left. What was the amount of his fortune?

Let his whole fortune = 1.
He loses $\frac{1}{3}$ and has $\frac{2}{3}$ left. He speculates with $\frac{1}{3}$ and loses $\frac{1}{4}$ of $\frac{1}{3} = \frac{1}{12}$.
He then has left $\frac{2}{3} - \frac{1}{12} = \frac{7}{12}$.
$\frac{7}{12}$ of his money = £2,800.
$\frac{1}{12}$,, = £400.
$\frac{12}{12}$,, = £4,800. Ans. £4,800.

2. A farmer gathers $\frac{4}{5}\frac{1}{5}$ of his apples. He then has 110 stolen, and finds that one half of his crop is left. How many were there at first?

Let crop = 1. He gathers $\frac{4}{5}\frac{1}{5}$ of it and has $\frac{5}{5}\frac{2}{5}$ left. Losing 110 reduces $\frac{5}{5}\frac{2}{5}$ to $\frac{1}{2}$. Therefore $\frac{5}{5}\frac{2}{5} - \frac{1}{2}$ or $\frac{1}{1}\frac{1}{0}\frac{2}{5} = 110$,
$\frac{1}{1}\frac{1}{0}\frac{1}{5} = 10$,
$\frac{1}{1}\frac{8}{5}\frac{6}{5} = 1860$ apples.
Ans. 1860.

3. I sold in the morning a part of a cargo of wheat at a profit of 20 per cent. In the afternoon the price fell 5s. per quarter, so that I made a profit of 12½ per cent. only on the rest. At what price per quarter did I buy the wheat?

Let buying price per quarter = 100.
Selling price in morning = 120,
,, afternoon = 112½,
Difference = 7½, or 5s.
If $7\frac{1}{2} = 5$s.
$1 = \frac{5}{7\frac{1}{2}}$,
$100 = \frac{5 \times 100}{7\frac{1}{2}} = 66\frac{2}{3}$ or
Ans. 66s. 8d. per quarter.

4. How can you tell without working out the division whether a vulgar fraction in its lowest terms if reduced to a decimal will or will not terminate?

Ans.—If the prime factors of the denominator of a fraction in its lowest terms contain no other figure than 2 or 5, it may be expressed as a finite decimal; if any other figure is present it will produce a recurring decimal.

5. Distinguish between the power of a number and the multiple of a number.

Ans.—The power of a number is that number multiplied *by itself* any number of times, the multiple is the number multiplied by any number, *e.g.*, 1,000 is a power of 10, for it is $10 \times 10 \times 10$; 80 is a multiple of ten, for it is 10×8.

6. Show that in reducing $\frac{1}{17}$ to a decimal, the number of figures in the period cannot exceed 16.

Ans.—When dividing by 17 the only possible remainders are the numbers from 1 to 16. At the 17th place one of these is bound to recur, and the decimal becomes a recurring decimal.

7. I have a mixture of lime and sand, the lime being $\frac{9}{17}$ of the whole. I add a bushel of sand and mix again. Now the sand is $\frac{10}{18}$ of the whole. How much lime is there? (Algebraic solution will be accepted.)

Let $9x$ = bushels of lime,
Then $8x$ = bushels of sand,
In 2nd case there are $9x$ bushels of lime and $8x + 1$ bushels of sand, and the proportion is, As $9x : 8x + 1 :: 9 : 10$,
That is $90x = 72x + 9$,
$18x = 9$,
$x = \frac{1}{2}$ and $9x = 4\frac{1}{2}$. Ans. $4\frac{1}{2}$ bush.

C.—*Geography.*

Asia Minor, Arabia, Persia, and Afghanistan.—Follow course pointed out in previous months. Draw maps for each, insert all places, etc., to be remembered, and practise thoroughly till known.

D.—*History.*

James II. and the Revolution.—Note the attempts to introduce Roman Catholicism, Declaration of Indulgence, Trial of the Seven Bishops and its result. Study particularly the constitutional points which were settled by the Declaration of Right.

E.—*Euclid.*

Second Year.—Revise Definitions, Axioms, and Postulates. Props. 1–4, four deductions per week.

Third Year.—Props. 22–30, Book I., and six deductions per week.

G.—*Algebra.*

Continue practice.

H.—*Teaching.*

Revision of any weak points.

Test Questions.

1. *Penmanship.*
Largehand.—Experimentally.
Smallhand.—Virtue alone is man's true happiness.

2. Write an essay on The influence of climate and surroundings on people.

3. Paraphrase and analyse all English set, and parse any difficult or obscure words.

4. What do you mean by the *treaty ports* of China? Name the chief of them and give their exact situation.

5. Describe carefully the trade and occupation of the people of Central Asia.

6. What points of resemblance can you discern between the Empire of Japan and Great Britain?

7. Where are Fusiyama, Kuro Sivo, Tokio, Nagasaki, and the Tokiado? Say for what they are noted.

8. Describe the Caspian Sea, its shores, ports, and traffic.

9. What are the characteristic features of Siberia in winter and in summer?

10. In what does the wealth of Siberia consist, and how do travellers move from one part to another?

11. What was the Navigation Act, and what results had it?

12. Account for Cromwell's remarkable success in fighting against the Cavaliers.

13. Briefly state the account of Cromwell's dealings with foreign powers.

14. Give particulars of the Protectorate of Richard Cromwell.

15. What was the Test Act, and when was it passed?

16. 3rd Year Boys (Set 15th October 1898, P.T. Examination).—

1. p persons each gave q pence to a charity. The expense of collection comes to r shillings. How many £ does the charity receive?
Ans. $\frac{pq - 12r}{240}$

2. Simplify—
$$\frac{(1 + ax + by)(1 + ax - by) - (1 - ax - by)^2}{(ax + by)(1 - by) + ax}$$
Ans. 2

$$\sqrt{\left(\frac{a^2 + b^2}{2ab} - 1\right)\left(\frac{a^2 + b^2}{2ab} + 1\right)}$$
Ans. $\frac{(a - b)(a + b)}{2ab}$

3. (*a*) How do you show that $x^p + x^q = x^{p+q}$, when $p+q$ are integers? Ans. (see Text Book.)

(*b*) Find the G.C.M. of $x^{2p} - 1 + x^{2p} - 1$.
Ans. $x^p - 1$.

4. Solve—

$$\frac{7}{x-4} - \frac{5}{x+3} = \frac{2}{x-5}. \quad \text{Ans. } 5\frac{16}{33}.$$

$$\frac{b}{x-a} + \frac{a}{x-b} = \frac{a+b}{x}. \quad \text{Ans. } \frac{a+b}{2}.$$

5. If 352 persons give each as many pence as the cost of collection comes to in shillings, and the charity thus receives £12 15s., how much does each give? Ans. 9d.

Mensuration.

1. What is the length of the diagonal of an oblong room, the area of which is 205⅓ square yards, and one side 56 feet?
Ans. 65 feet.

2. A triangular field of 4 acres 35 square poles is bounded by a railway, a canal, and a road. The distance along the road from the canal to the railway is 1 furlong 20 poles. How far from the road is the point where the railway crosses the canal? Ans. 22½ poles.

AUTUMN EXAMINATION, 1899.

THIRD MONTH—DECEMBER.

WORK TO BE PREPARED.

A.—*English.*

First Year.—Prepare fully lines 49–76 of 'The Bard.'

Second Year.—Prepare fully lines 97–136 of 'The Deserted Village.'

Third Year.—1. Learn 20 roots and meanings per week.
2. Prepare lines 80–122, Pope's 'Essay on Man,' Ep. IV.

Pay great attention to the paraphrases. Prepare the notes given below, and write if you find any difficulty beyond what is here dealt with.

(For full notes on Parsing, Analysis, and Paraphrase, see July Number.)

B.—*Arithmetic.*

First Year.—Boys.—Application of Fractions to Weights and Measures.

Girls.—Compound Practice.

Second Year.—Boys.—Simple Interest.

Girls.—Application of Vulgar Fractions to Money Weights and Measures.

Third Year.—Boys.—General Problems on Square and Cubic Measure.

Girls.—Simple Proportion.

C.—*Music.*

First Year.—Accent. Two, three, and four pulse measures.

Second Year.—Six and nine pulse measures.

Third Year.—Relative Pitch of Keys.

D.—*Geography.*

Norway, Sweden, Denmark, Germany.—This will need very careful preparation. Draw maps for each country. Insert all names to be remembered and go over continually till known.

Pay special attention to Productions, Industries, Towns, and Forms of Government.

E.—*History.*

The Wars of the Roses. Edward IV., Edward V., and Richard III. For Notes, see PRACTICAL TEACHER for May.

F.—*Euclid.*

Second Year.—Props. 5–8, Book I.

Third Year.—Props. 36–40, Book I., and four deductions per week.

G.—*Algebra.*

Factors.—The greatest care should be taken with these, as upon a proper understanding of them depends much future work. Everyone should thoroughly understand the application of these formulæ.

$$(a+b)(a-b) = a^2 - b^2;$$
$$(a+b)^2 = a^2 + 2ab + b^2;$$
$$(a-b)^2 = a^2 - 2ab + b^2;$$
$$(a+b)^3 = a^3 + 3a^2b + 3ab^2 + b^3;$$
$$(a-b)^3 = a^3 - 3a^2b + 3ab^2 - b^3;$$
$$(a^4 + a^2b^2 + b^4) = (a^2 + ab + b^2)(a^2 - ab + b^2).$$

H.—*Teaching.*

Prepare Notes of Lessons weekly.

Second Year.—Chap. III., 'Scholarship School Management.'

Third Year.—The Teaching of History—its value as a school subject; method of teaching; Biography as a help to the study of history.

TEST QUESTIONS.

1. *Penmanship.*
Largehand :—Generally, Hieroglyphics, Illimitable.
Smallhand :—See, Falkland dies, the virtuous and the just.

2. *Composition.*—Write an essay on 'The Influence of Printing.'

3. Paraphrase and analyse all the English set, and parse any word that is not perfectly clear.

4. What do you understand by the Standard Scale of Pitch? Give the mental effects of **m, f, l, t** and say how they may be modified.

Second Year.—Rewrite the following, making a change to the first flat key at (*a*), and return to the original key at (*b*) :—

(*a*) (*b*)
d m s r f m l ta d' ta s m l s m d

Third Year.—Explain the principle on which the chromatic tones are named. What are the names of *me* sharp, *ta* sharp, *fah* flat, *doh* flat?

5. Give the chief vegetable productions of the south of Europe, and point out places specially noted for the cultivation of the vine.

6. In what parts of Europe are gold, silver, lead, and coal found?

7. Construct a table showing the relation of the various races of Europe to each other, and point out, if you can, the order of their settlement in Europe.

8. What are the chief industries of France? What towns (if any) are specially connected with each?

9. Describe with a sketch map a coasting voyage from Calais to Bordeaux.

10. Discuss Henry IV.'s right to the Throne and the results of his accession.

11. Describe Henry V.'s conquest of France, and give the terms of the Treaty of Troyes.

12. What do you know of Joan of Arc?

13. What is meant by the terms Induction, Deduction, Intuition, Analysis, and Synthesis as applied to teaching?

14. Explain your method of teaching the common definitions in geography.

SCHOLARSHIP COURSE FOR DECEMBER, 1898.

1. *Penmanship.*—Ten minutes' daily practice *from a good model.*

2. *Composition.*—Write one or two essays per week, selecting from the following :—
(*a*) Savings Banks.
(*b*) Birds of a feather flock together.
(*c*) Chief inventions of the present century.
(*d*) Ambition.
(*e*) Use and abuse of riches.
(*f*) Moral courage.
(*g*) Imports and exports.
(*h*) Intelligence in domestic animals.

3. *Other Subjects.*—The time now remaining must be well spent in revision of salient points which have been indicated from month to month. If the advice given has been carefully followed, no student need fear the examination as far as knowledge is concerned. The Memory maps need careful practice. Egypt is the most likely one to occur, owing to recent events. Note-books, if properly kept, should prove most useful for revision purposes. The Theory of Arithmetic should again be revised, and exact definitions learnt of all the terms which are commonly used.

It only remains for me to point out a few rules which should be carefully observed at the examination itself.

1. Provide yourself with everything that is likely to be needed, including your permission to sit, and any Science and Art certificates which will carry marks.

2. Before doing anything else, fill in the form on the outside of your book.

3. Read carefully the instructions given with each paper.

4. Divide your time between the questions in proportion to their importance.

5. Attempt all compulsory questions.

6. Revise all your answers carefully.

7. Avoid discussion of papers which have been worked.

8. Do *no* study during Scholarship week.

9. Avoid any confusion, keep cool, and if any paper is not to your liking, endeavour to make up for it in other subjects.

I wish those who have followed this Course every success.

REMAINING TEST PAPERS.

Geography (1¾ hours, 100 marks).

Answer the first question and five other questions.

1. Draw a map of Egypt *or* a map of the West Coast of Ireland.

2. Write four or five lines about 4 of the following :—
Port Arthur, Santiago, Lhassa, Quebec, Baku, Johannesburg, Delhi.

3. Describe as fully as you can the province of Victoria, dealing more particularly with its climate, natural products, and the nature of its trade with the British Isles.

4. What are the chief imports and exports of the West Coast of Africa? Name the seaports.

5. Explain as clearly and concisely as you can the various forms of government in our colonies.

6. How is the deficiency in the home supply of animal food for the people of England rectified?

7. Give a general description of the islands belonging to England in the Pacific, and point out their commercial importance or otherwise.

8. Write 12 or 15 lines on *two* of the following :—

(*a*) West Indies Sugar Industry.
(*b*) Recent events in Cuba.
(*c*) The native states of India.
(*d*) Australian Federation.
(*e*) The Royal Niger Company.
(*f*) The government of China.

History (1½ hours, 100 marks).

Candidates may not answer more than 4 questions.

1. Point out and explain what you consider the *four* chief legislative measures before 1603.

2. What difficulties confronted Elizabeth on her accession? How were they overcome?

3. Trace the causes which led to the Civil War in the reign of Charles I.?

4. Why did England take part in the war of the Spanish Succession? Give the terms of the Treaty of Utrecht.

5. Explain the circumstances and the political importance of the trial of Dr. Sacheverell.

6. Say what you can of the social life in the reign of Queen Anne.

Domestic Economy (Two hours, 80 marks).

Candidates are not allowed to answer more than *one* question in each section.

SECTION I.

1. Explain as fully as you can what is meant by 'nutritive food,' and name six kinds of such food in the order of their value.

2. What are the relative values of vegetable and animal food in maintaining the body in health? Name a few of the most useful articles of each class of food.

SECTION II.

3. Name the different articles required in the equipment of a kitchen, and give their cost and use.

4. What are 'condiments'? Name four of those in most general use. Say whence they are obtained and what purpose they serve.

SECTION III.

5. Name the staple materials of clothing in use among the labouring classes. Give some account of each, and of its special value.

6. There has grown up of late a considerable feeling against dyed wool and in favour of 'natural wool.' Explain why this is, and state your own opinion on the matter.

SECTION IV.

7. Mention the ordinary causes of the beginning of fevers, and explain the practice of isolating patients.

8. How would you distinguish 'venous' and 'arterial' bleeding? and how would you treat each?

SECTION V.

9. Define what is meant by *pure* air, and show the need for a constant supply.

10. What is a 'draught'? State the dangers to health arising from a draught, and point out how ventilation may be secured without it.

SECTION VI.

11. Describe the facilities for investing small sums of money. What is the chief factor in determining the Rate of Interest on an Investment?

12. What portion of an income should be spent on house-rent? Explain the nature of Building Societies, and of Fire and Life Insurance.

Needlework (Two hours).

The exercises in *one* section only to be worked.

SECTION A.

Cut out in paper (¼ size) and make up by tacking a woman's flannel petticoat; *and*

Bind two sides of a piece of flannel, showing how the corner is done; *or*,

SECTION B.

Cut out in paper (¼ size) and make up by tacking a pair of drawers suitable for a child of eight; *and*

Make a flannel patch not less than two inches square.

Marks will be given for *industry* and *finish*.

Algebra and Mensuration (Two hours, 125 marks).

Answer 7 questions on Algebra and 1 on Mensuration.

1. Resolve into elementary factors :—

(1) $x^2 - 3x - 130$.
(2) $x^4 - 81$.
(3) $a^2(b-c) + b^2(c-a) + c^2(a-b)$.

2. Prove the rule for finding the G.C.M. of two algebraical expressions, and find the L.C.M. of

$$x^2 - 3x + 2,\ x^2 - 5x + 6,\ x^2 - 7x + 12.$$

3. Many Pupil Teachers, when asked to prove a formula, simply give a numerical illustration. Explain why this is worthless. Prove the rule for the multiplication of algebraical quantities, *e.g.*, $a^m \times a^n$.

4. Find the square root of

$$x^6 - 8x^5 + 24x^4 - 34x^3 + 24x^2 - 8x + 1.$$

What must be the value of a so that $x^4 + 2x^3 + 5x^2 + 4x + a$ may be a square?

5. Solve the equations

(1) $\dfrac{4x-3}{2} - \dfrac{5x-4}{3} = \dfrac{6x-5}{4} - \dfrac{1}{12}$.

(2) $(x-3)(x-4)(x+12) = x^3$.

(3) $x + y = 8$; $15x^2 - 34xy + 15y^2 = 0$.

6. Simplify $\dfrac{ab(a-b) - a(a-1) + b(b-1)}{(a-b)(a-1)(b-1)}$,

and find the value of

$(x^2 + xy + y^2)(x^2 - xy + y^2)$ when $x = 2\frac{1}{2}$, $y = 3\frac{1}{2}$.

7. A bag contains sovereigns and shillings. If the number of sovereigns is doubled, the contents of the bag will be worth £21; but if the number of shillings is doubled, the contents will be worth £12. Find the number of each kind.

8. Find the G.C.M. of

$$91(x^3y - 3x^2y + 7xy - 21y) + 78(2x^4y^2 + 19x^2y^3 + 35y^4).$$

9. A picture has a margin of the same width all round and is enclosed in a rectangular frame 4 ft. 8 in. long, 2 ft. 9 in. broad, internal measure. Find the length and breadth of the picture if its area = the area of the margin.

Mensuration.

1. The sides of a triangle are 44 ft., 75 ft., 97 ft. (*a*) What fraction of an acre is its area? (*b*) What are the lengths of the three perpendiculars from its angles on the opposite sides?

2. Find the cost of making a path 7 ft. wide round the outside of a circular ground whose perimeter is 352 yds. at 3s. 9d. per square yd. ($\pi = \frac{22}{7}$).

Euclid (Two hours, 125 marks).

N.B.
- All generally understood abbreviations for *words* may be used, but symbols of operation (−, ×, +) are not admissible.
- Capital letters, not numbers, must be used in the diagrams.
- *All* questions may be attempted. Marks are given for portions of questions. The style and arrangement of the answers will be considered.

1. Derive and explain Quadrilateral, Isosceles, Parallelogram, Rectangle.

Draw figures to prove that figures equal in area need not be of the same shape.

What is a Corollary? What do Q.E.F. and Q.E.D. mean?

2. If two angles of a triangle be equal to one another, then the sides also which subtend, or are opposite to, the equal angles, shall be equal to one another.

ABC is an isosceles triangle, and the equal angles ABC and ACB are bisected by CD and BD, which meet at D. Prove that DBC is an isosceles triangle.

3. The opposite sides and angles of a parallelogram are equal, and the diagonal of a parallelogram bisects its area.

When does the diagonal of a parallelogram bisect the opposite angles?

4. If the square described on one side of a triangle be equal to the sum of the squares described on the other two sides, the angle contained by these two sides is a right angle.

Of all the parallelograms which can be formed with diameters of given lengths, the rhombus is the greatest.

5. If a straight line be divided into any two parts, the square on the whole line is equal to the sum of the squares on the two parts together with twice the rectangle contained by the two parts.

Express this algebraically.

6. To divide a given straight line into two parts so that the rectangle contained by the whole line and one of the parts may be equal to the square on the other part.
Express this algebraically and solve the equation so formed.

Notes on Scholarship Test Exam.

THE ENGLISH PAPER.

1. *Without all doubt or controversy* = Enlarg. of *secure*.
Yet = Conj., joining *My nature is*, etc., and *I do not infer*, etc.
rather = Adv. of Degree mod. *than*.
defenceless = Adjectival Completion of *is left*.

2 and 3. Text-book.

4. Nominatives: (*a*) Simple, (*b*) in Apposition, (*c*) of Address, (*d*) Absolute. Objectives: (*a*) Simple, (*b*) Indirect or Dative, (*c*) Cognate, (*d*) Factitive, (*e*) Adverbial, (*f*) Residual, (*g*) Absolute (rare—found in Milton).

5. Farther = Comparative of Distance, *e.g.*, He went farther.
Further = Comparative of Degree, *e.g.*, To proceed further with the argument.
Older = applied to persons or things.
Elder = applied to persons only.
Later = in point of time.
Latter = in point of order or mention.

9. The effects of the Norman Conquest on the *Anglo-Saxon* were (1) to cause the loss of the majority of inflections, (2) to destroy the power of compounding words, (3) to degrade many words in meaning.

ARITHMETIC.

Section I.

1. (*a*) Answer, 335.
(*b*) Answer, 7 — 6 — 5.
(*c*) 297 is made up of some units, some 7^s and some 56^s,
$\therefore$ 56|297
5 + 17
$= 5(56) + 2(7) + 3(1)$. Ans. 3, 2, 5.

2. Text-book.

3. (*a*) There can be no ratio of books to money. Should be—
As 3 : 5 : : 4s. 6d. : 7s. 6d.
(*b*) The unknown may be any of the 4 terms.
(*c*) Duplicate Ratio of $2 : 3 = 2^2 : 3^2 =$ 4 : 9.
Compound Ratio of 3 : 4, 5 : 6, 8 : 5
$= 3 \times 5 \times 8 : 4 \times 6 \times 5 = 120 : 120 =$ 1 : 1.

4. Text-book.

Section II.

Subtract 7 from each. Then find G.C.M. = 29.

6. Ans. 1220670.

7. Ans. ·596078 +.

8. Ans. $3\frac{1}{2}\frac{2}{5}\frac{7}{5}\frac{8}{8}$.

9. Ans. ·5.

10. 3 men do 42 acres, $\therefore$ each does 14. | [A does 14 of his own, leaving 1 for man; B does 14 of his own, leaving 13 for man.
Man does $\frac{1}{14}$ for A = 3s., and $\frac{1}{13}$ for B = 39s. Ans. 3s., 39s.

11. Ans. $3\frac{1}{2}$ years.

12. Ans. 33·58.

Section III.

13. Ans. 84.

14. Ans. £4,767 4s. 2d.

15. Split up number into prime factors
$= 2 \times 2 \times 2 \times 3 \times 3 \times 3 \times 7 \times 7$
$= 2^3 \times 3^3 \times 7^2$.
Hence to make a cube it must be multiplied by 7. Ans. 7.

16. Ans. $77\frac{1}{2}$.

17. Ans. 60 days.

18. Ans. £120.

ALGEBRA.

1. $-2c$; $12(a^2 + 1)$.
2. $8(a - b + c)(a - c)$; $a^2 + 2ab + 3b^2$.
3. $2x^2y^2 + 2xy + 1$; 61.
4. 161, 138.
5. $5\frac{1}{7}$; 11; 8.
6. 24 men, 12 women.

MUSIC (*Answers*).

s, m : f, : m	d : — : —
r : —, f : l,	t, s, f : r : m

2. m' s } Major 6th, f d } Perfect 4th, m r } Major 2nd,
d' fe } Imperf. 5th, s f } Major 2nd, d' se } Dim. 4th,
ta f } Perfect 4th, fe m } Major 2nd.

3. (*a*) m s f l ^{m}l$_1$ t$_1$ r d f l$_1$ r t s ^{d}s d m f r d.
(*b*) m s d' s ^{t}m f m t l f r t$_1$ d ^{r}l s d' t r' d.

4. l$_1$ t$_1$ d r m bah se l; l se f m r d t$_1$ l$_1$.

5. Highest, Soh in B♭; Lowest, Soh in E♭.

6. Text-book.

ALGEBRA AND MENSURATION.

1. $(x + 10)(x - 13)$; $(x + 3)(x - 3)(x^2 + 9)$; $(a - b)(c - a)(c - b)$.

2. Text-book; $x^4 - 10x^3 + 35x^2 - 50x + 24$.

3. Text-book. A numerical illustration is useless, because it merely proves the truth in *one* instance, and not generally.

4. $x^3 - 4x^2 + 4x - 1$; $a = 4$.

5. 1; 12 or $\frac{1}{8}$; 5 or 3, 3 or 5.

6. 1; $265\frac{1}{18}$.

7. 10 sovereigns, 20 shillings.

8. $13y\ (x^2 + y)$.

9. 3 ft. 8 in; 1 ft. 9 in.

MENSURATION.

1. $\frac{9}{88}$ acr., $32\frac{84}{97}$ ft., $42\frac{6}{25}$ ft., 72 ft.

2. £157 4s. 2d.
By formula Circumference $= 2\pi r$,
that is $352 = 2 \times \frac{22}{7} \times r$,
$r = \frac{352}{1} \times \frac{1}{2} \times \frac{7}{22} = 56$ yds. $= 168$ feet.
Radius of outer circle $= 168 \times 7 = 175$ feet.
Area of ring $= \pi(R + r)(R - r)$
$= \frac{22}{7} \times 343 \times 7$ sq. feet
$= \frac{22}{7} \times 343 \times 7 \div 9$ sq. yds.
Cost $= \frac{22}{7} \times \frac{343}{1} \times \frac{7}{1} \times \frac{1}{9} \times \frac{15}{11}$
$=$ £157 14s. 2d.

CORRESPONDENCE.

RULES AS USUAL.

All communications and queries with regard to the PUPIL TEACHERS' AND SCHOLARSHIP COURSE should be addressed to 'A. T. FLUX, The Bays, Belvedere, Kent.'

ANSWERS TO CORRESPONDENTS.

Veronique.—Essay, 50/60. Hardly long enough for exam. purposes. 'Androcles,' not 'Androclus.'

Dorothy.—Map, 28/30. Printing should be bolder. You have the boundary stopping at Wadi Halfa. That is, of course, incorrect. It runs now, theoretically at least, to the Great Lakes. Penmanship, 48/60. Loops to letters too narrow.

Caxton.—Penmanship, 48/60. Downstrokes too thick, general style too stiff, lacking in ease and grace. Essay, 40/60; not written on a good analytical plan, ideas too trite and commonplace.

Mab.—Map, 25/30. See notes given on Map-Drawing in previous number of PRACTICAL TEACHER. Boundary wrong; see above. Penmanship, 55/60. Essay, 60/60; very good.

Marcus (Hereford).—Essay, 55/60. Penmanship, 53/60; downstrokes too thick.

Enquirer.—(*a*) This might be in C minor (relative to E♭ major). The C sharp would then be the major 6th ascending. (*b*) This might be in E or F minor, D sharp being major 6th or 7th. (*c*) This might be in A minor, G sharp being the major 7th. There is no rule I can give. Ability to answer depends upon a knowledge of the signatures of the various scales, and what is the 6th and 7th of each.

C. H. F.—See above.

'1899.'—(*a*) A complete list of Text-books for Scholarship 1899 will be given in the January number. (*b*) Write for Syllabus to the Secretary, Education Department, Whitehall, London, S.W.

Puzzled.—In a sentence like 'He grew tall,' 'tall' is *not* an Adverb, but the Adjectival completion of the Predicate—a common construction in English, where we use an Anglo-Saxon verb with some other word following in place of a verb from the classical language. *Even* may be an Adjective of Emphasis, as 'Even the king was dismayed'; an Adverb of Emphasis, as 'Even now I set me down' (mod. '*now*'), or 'Even when he came he was useless' (mod. the Adv. sent. 'when he came').

(*Other Correspondents answered by post.*)

OUR NEW CERTIFICATE COURSE FOR 1899.

By GEORGE COLLAR, B.A., B.Sc.,
Headmaster of the Stockwell Pupil-teacher School.

TEST QUESTIONS ON THE WORK FOR OCTOBER.

THEORY OF TEACHING.

FIRST YEAR.—1. What steps would you take to correct children who use dentals for gutturals, *e.g.*, *doat* for *goat*; *tatch* for *catch*?

2. When should the teacher give a 'pattern reading?' What are the dangers to be avoided in 'pattern reading?'

3. Say how you would conduct a class of older children in 'silent reading.'

4. What are the advantages and what are the disadvantages attending the use of Historical, Geographical, and Science Readers?

5. Under what conditions may simultaneous reading be taken?

6. What is ambiguity? Point out the ambiguity in the following:—(*a*) The farmer has lost all his black and white cows. (*b*) The minister taught his children the sin of drunkenness. (*c*) To-day he puts forth the tender leaves of hope, to-morrow *blossoms*.

7. What is meant by the extension of a term? Arrange the following in order of their extension:—Quadruped, puppy, animal, dog, vertebrate, mammal, thing.

8. Under what circumstances have words been introduced from other languages into English?

SECOND YEAR.—1. Of what use is the study of psychology to a teacher?

2. What do we mean by the 'Mind?' How is the mind related to the body?

3. Describe the arrangements by which we are able to see at one time distant objects and at another time near ones?

4. How should the desks be arranged in a class-room with respect to the windows?

5. What are the principles underlying all sound methods of ventilation? Describe a system by which the fresh air may be warmed as it enters the class-room.

6. What amount of floor area, and what cubical space should be allowed per child?

ARITHMETIC.

1. Is there such a thing as a 'Concrete Number?' If all numbers are abstract, why is it permissible to speak of an 'abstract number?'

2. What is a 'Unit?' Why are there several units of the same kind (*e.g.*, of length, or weight) in use?

3. What is meant by 'Complementary Addition?' What are its advantages?

4. Divide 3,785,624 by 763 by the Italian method, and explain the working as to a class.

5. A number is divided by 385, by means of factors, and the remainders in the three steps are respectively 9, 6, 3, what will they be if the order of the factors is reversed?

ENGLISH.

FIRST YEAR.—1. Why do we regard modern English as derived from the language spoken by King Alfred, seeing that the majority of the words are of Latin origin?

2. Give a detailed account of Milton's life at Cambridge.

SECOND YEAR.—1. What dramatic works had been written in English before Shakespeare's time?

2. Institute a comparison between the circumstances of King Lear and those of Gloucester.

3. Where is 'the Forest of Arden?" From what source did Shakespeare derive his materials for the play of 'As you like it?"

ENGLISH HISTORY (*both years*).

1. Show, by means of a table, the claim of James I. to the English throne.

2. What do you know of the condition of the continental states at the time of the accession of James I.?

3. Who was Arabella Stuart? What plots were entered into on her behalf?

GEOMETRY.

WOMEN.—1. What is an enunciation? Of what parts does the enunciation of a theorem consist?

2. Define a 'right-angled triangle' and an 'isosceles triangle.' Can the same triangle be both right-angled and isosceles?

3. How many equilateral triangles can be constructed on the given line in Prop. I.?

MEN—FIRST YEAR.—1. AB is a given straight line, and C and D two points on opposite sides of it. Find a point E in AB, such that when it is joined to C and D, the lines EC and ED shall be equal.

2. Prove I. 17 without producing one side.

SECOND YEAR.—1. When is one figure said to be inscribed in another? If a circle be inscribed in a triangle and a square be inscribed in this circle, can we say that the square has been inscribed in the triangle?

2. The centre of the circle circumscribed about an equilateral triangle coincides with the centre of that inscribed within it, and the diameter of the former circle is twice that of the latter.

LATIN.

BOTH YEARS.—1. Decline in the singular and plural: ingens rus, rex tristis, bos aliquis.

2. Give the genitive singular and plural of: nubes, mus, caput, res, veru, aestas, tussis, gens, frons, panis, tellus, lepus, onus, alter.

3. Distinguish between the Interrogatives quis and qui.

FRENCH.

BOTH YEARS.—1. Give the plurals of: jumeau, fou, chou, gu, voix; madame, monsieur, mademoiselle, chef-lieu, arc-en-ciel, hôtel-Dieu, prie-dieu, reveille-matin, garde-robe, garde-champêtre.

2. Give the feminines corresponding to fils, cheval, singe, roi, ambassadeur, paon, empereur, baron, pair, lecteur, and chasseur.

3. What are the different forms of the Partitive Article? In what cases is *de* only used?

GEOGRAPHY (*both years*).

1. If the Suez Canal were to be closed to English ships, which of our colonial trading ports would be affected (*a*) advantageously, (*b*) disadvantageously, by such an event? Give reasons for your answer.

2. What are the various routes and means of travelling by which England is connected with her dependencies in the East?

3. A ship steams from Calcutta to Melbourne, and stops at every British possession in the Malay Peninsula and on the islands south of it. Name the places where it would stop? Mention anything of interest a passenger would see.

TEST QUESTIONS ON THE WORK FOR NOVEMBER.

THEORY OF TEACHING.

FIRST YEAR.—1. What are the principles underlying Mulhauser's method of teaching writing? State the advantages and disadvantages of the method.

2. What is a 'categorical proposition'? How many different kinds of categorical propositions are there? Give two examples of each.

SECOND YEAR.—1. What are the functions of the Medulla Oblongata? How does its general structure differ from that of the Cerebrum?

2. Show that the feeling, the intellect and the will are closely related one to another.

ARITHMETIC.

1. Show that the L.C.M. of the squares of two or more numbers is the square of their L.C.M.

2. Show that if a prime number divides the product of two numbers to one of which it is prime, it must be a factor of the other.

ENGLISH.

FIRST YEAR.—1. Account for the presence of words of Danish origin in the English language. Give examples.

2. Say what you know of the class of poetry to which Lycidas belongs.

3. Discuss Milton's references to the rulers of the Church in his time.

SECOND YEAR.—1. To what period of British History is the story of King Lear supposed to belong? Mention any anachronisms you have noticed.

GEOGRAPHY (*both years*).

1. Describe the *causes* and the *effects* of the very unequal rainfall in different parts of India.

2. What changes have taken place in the staple productions of India of late years?

3. Contrast the eastern and western sea-boards of the Dominion of Canada.

HISTORY (*both years*).

1. Give an account of Strafford, *or* Laud, *or* Buckingham.

2. Give an account of the fundamental political principles on which the two parties differed at the outbreak of the Civil War.

GEOMETRY.

WOMEN.—Prove that only two equilateral triangles can be constructed on the same straight line, namely, one on each side of it.

MEN—FIRST YEAR.—In a given straight line of unlimited length find a point which shall be equidistant from two given points. When is this impossible?

MEN—SECOND YEAR.—Show how to describe a circle passing through three given points.

LATIN (*both years*).

1. Give the perfect (1st pers. sing.), and the supine in *-um*, of the following verbs: flecto, coquo, traho, vivo, vincio, vinco, mulceo, mulgeo, domo, palleo, pallesco, scando.

2. Translate into Latin:—Lead out all your men with you; or at least, as many as you can; cleanse the city. You will deliver me from a great fear; only let there be a wall between me and you.

FRENCH (*both years*).

1. Give the future, third person singular and plural of:—pouvoir, venir, savoir, envoyer, pourvoir, voir asseoir, mouvoir and mourir.

2. Translate: He knows very well that these orders that I am giving him in an ill temper are only pretexts for staying in bed without seeming to wish to do so.

SYLLABUS OF WORK FOR DECEMBER.

THEORY OF TEACHING.

FIRST YEAR.—1. *Methods of teaching Arithmetic.*

Apparatus:—ball-frame, (abacus), kindergarten sticks and cubes, models of coins, actual weights and measures. Number; an abstraction from a number (or collection), of things, hence the different numbers of individuals must be first recognised, then the idea of number abstracted. This is most important; yet, although arithmetic is the science of number, many senior scholars are quite ignorant of what a number is. Thus in a lesson on the number **two**, the teacher has (*a*) to get the children to recognise **two objects**, *e.g.*, cubes, using repeated analysis and synthesis, (*b*) to give an idea of the **number** of times the two blocks contain one block, (*c*) to associate the number with its symbol **2.**

Notation and Numeration, the method of A. W. Grube. The decimal system, use of French coins in illustration. The combined method of teaching addition and subtraction. The other advantages of Complementary Addition. Multiplication and Division. Importance of teaching children to observe the place-value of the digits. Illustrations for teaching the Compound Rules.

Fractions; Graphic illustrations. Decimals, methods absolutely the same as for whole numbers if children have been made to observe place-value. Proportion to be based on Fractions.

2. *Logic.*—The ways in which propositions may be opposed to one another. Euler's method of representing the relations between propositions.

SECOND YEAR.—1. *Psychology.*—Differences between sensations and perceptions. Attention, voluntary and involuntary. The 'focus' and the 'fringe' of the field of attention. Means of bringing things to the 'focus.' Dependence of attention on interest either intrinsic or extrinsic. Means of stimulating the attention, example, manner of presentment, example, and emulation; means of developing habits of attention.

2. *School Hygiene.*—Arrangements for cleansing the rooms. Attention to children's eyesight. Use of card for testing eyesight. Teacher to act on result only by putting short-sighted children in front seats, and recommending parents to take bad cases to an oculist.

ARITHMETIC.

Vulgar fractions, paying special attention to the methods of proving the different rules, and to the graphic and other illustrations used in teaching the rules to children.

THEORY OF MUSIC.

Staff Notation.—Relations between notes in the same scale, tonic, dominant, etc. Transposition from one major scale to another.

Tonic Sol-fa Notation.—The chordal structure of the common major scale, relations of the various notes to the scale—tonic, mediant, etc. The standard scale of pitch, and the relations (in pitch) of the various keys. Names of chromatic tones, use of chromatic tones to avoid change of key.

ENGLISH.

FIRST YEAR.—Complete the study of sources from which words have been borrowed.

F.—*Greek.*—(*a.*) After incorporation into Latin, many Greek words were introduced as Latin words in the second period, *alms, bishop, priest, psalm.*

(*b.*) In a similar manner through the French, as *blame* (Fr. *blâmer*), a doublet with *bl spheme, fancy.*

(*c.*) Modern words, mostly technical. One characteristic of Greek is the readiness with which new compound words are formed from its roots. Thus we have large numbers of compound words—formed, not from any compound words known to the ancient Greeks—used as names of things quite recently invented, and formed by putting together two or more Greek root words, *telephone, phonograph, hydrogen, cacodyl.*

Words of Greek origin may generally be identified (i.) by the following combinations of consonants: *rh* (initial), *-rrh* (medial or final) *ph, ps, -sm* (final), *rhetoric, catarrh, physic, psychology, baptism.*

(ii.) By *y* used as a medial vowel, *cycle.*

(iii.) By their prefixes and suffixes.

G.—Modern words introduced from all parts of the world. The student should not attempt to learn them off by heart, but as these words are nearly all nouns, a study of the origin of the thing itself will afford the most interesting and most effective way of mastering the origin of the name.

BOTH YEARS.—Addison's Essays. There can be no doubt that the expression Addison's 'Selections from the *Spectator*' (Golden Treasury Series) is meant to include all the essays in that volume, although many of them never appeared in the *Spectator* at all, but were contributed to the *Tatler* and other periodicals, for which Addison wrote.

Study the introduction and the papers on Sir Roger de Coverley, and note down references to the life and conditions of the time—the political and religious parties, and the social customs of the people.

SECOND YEAR ONLY.—Careful study in detail of Acts I. and II. of 'King Lear,' noting allusions, grammatical constructions, and derivation of words.

GEOGRAPHY (BOTH YEARS).

British Arctic America, though politically included in the Dominion, it is (like the Polar regions owned by the United States and Denmark) the land of the Eskimo. It includes territory on the mainland and islands. The most important should be traced on the map, and the positions of the chief 'lands' and islands learned.

A concise account of the search for, and discovery of, the North-West Passage should be studied.

Newfoundland and Labrador, the only part of British North America which has not joined the Dominion.

Note the details of the important fishing trade of Newfoundland.

Bermudas.—Important victualling station on the route from England to the West Indies.

2. *In Central America.*—Learn positions from map, and divisions into groups.

Study general characteristics, and then the most important facts about individual islands.

Read account of discovery by Columbus, and of the struggles in the 16th, 17th, and 18th centuries between the European powers—especially Spain, France, and England—for possession.

Note in 18th century—

(*a.*) Development of the sugar trade, and consequently of the slave trade;

(*b.*) The Maroon wars in Jamaica between runaway slaves and their masters;

and in the 19th century—

(*a.*) Effect on sugar trade of the Abolition of Slavery;

(*b.*) Introduction of Indian coolie labour, and attempts to grow fruits, sisal hemp, etc.

Study the present condition of their trade.

ENGLISH HISTORY (BOTH YEARS).

The Civil War, 1642–1649.

Composition of the two parties: (*a*) their social classes, (*b*) geographical distribution.

The course of the war must be followed with the help of a good atlas and some blank maps.

Affairs in Scotland; Solemn League and Covenant.

The various battles and their *effects.*

The internal quarrels in the Parliamentary Party after the surrender of the King.

Trial and execution of the King.

GEOMETRY.

WOMEN.—*First Year.*—To end of Proposition XV.

MEN.—*First Year.*—Revise Book II. The chief difficulty in the second book arises from the fact that there are two different ways of describing a rectangle, etc., one by a reference to the area it covers, and the others by a reference to the lines that contain it. Thus the accompanying figure may be described as the rectangle ABCD (or AC), or as the rectangle contained by AB and BC. The student should carefully notice this double notation, and see that most of the propositions are proved, by showing how the smaller figures fit together to form the larger ones, the first system of notation being employed in this stage; the next stage consist of making the necessary changes from one notation to the other. The above is really the key to the whole book.

MEN.—*Second Year.*—The fifth book is not required, but as some of the proofs in the sixth book depend upon matter contained in the fifth, the student should learn those definitions and propositions (enunciations only) of the fifth book, which are quoted as references in the sixth. Next, study Book VI. definitions and Propositions I.—V.

ALGEBRA.

WOMEN.

Common measures and common multiples; their deduction from the prime factors of an expression, and their determination by the ordinary rules.

N.B.—Always factorise the expressions if you can. See below.

MEN.

FIRST YEAR.—Algebraical fractions, their addition, subtraction, multiplication, division, and simplification. Examples in these rules require skill in factorising. See below.

MEN.

SECOND YEAR.—Study Theory of Equations; see Todhunter, Chap. XX. and XXII.; Chap. XII in the 'Intermediate Algebra' (U. C. C.).

The following hints on factors will be useful to all :—

(i.) The difference between the squares of two quantities = the *sum* of the quantities multiplied by their difference.

$$a^2 - x^2 = (a + x)(a - x).$$

(ii.) The squares of binomial expressions take the form of

$$a^2 + 2ab + b^2 \text{ or } a^2 - 2ab + b^2.$$

(iii.) In expressions such as $x^2 + 11x + 24$ and $x^2 - 11x + 24$, we know that the product of the second terms of the two factors being positive, the signs of those terms must be *the same*; and as the coefficient of x is the sum of those terms, we know that in the first case they are both + and in the second both —. Hence we have to find two numbers whose product is 24 and whose sum is 11.

$$x^2 + 11x + 24 = (x + 8)(x + 3);$$
$$x^2 - 11x + 24 = (x - 8)(x - 3).$$

(iv.) Similarly, in expressions such as $x^2 + 5x - 24$ and $x^2 - 5x - 24$, from the last term being negative we know that the signs of its factors are *unlike*; and the coefficient of x being their *algebraical* sum, we notice that in the first case the greater factor of 24 is positive and in the second negative. Hence we have to find two numbers whose product is 24 and whose *algebraical sum* (or *arithmetical difference*) is 5. They are 8 and 3.

$$\therefore\ x^2 + 5x - 24 = (x + 8)(x - 3)$$
$$\text{and } x^2 - 5x - 24 = (x - 8)(x + 3).$$

The methods of factorising expressions dealt with in (i.)—(iv.) are generally well set out in the text-books, but for expressions of the form $7a^2 - 23a + 6$ the student is left largely to his own devices.

(v.) An expression of the form $7a^2 - 23a + 6$ may be factorised by the following method: since the first term $7a^2$ is not a perfect square, but $7 \times 7a^2$ is, let us multiply the expression by 7 and divide the product by 7, when

$$7a^2 - 23a + 6 = \frac{(7a)^2 - 23(7a) + 42}{7}.$$

The numerator of this fraction may now be factorised by (iii), for it is of the form $x^2 - 23x + 42$, in which $x = 7a$. Hence $7a$ is the first term in each factor, and for the others we must find two numbers whose product is 42 and whose sum is 23. We see at a glance in this case that they are 2 and 21; but should we have any difficulty, we can soon run through all the possible pairs of factors of 42, viz., 1×42, 2×21, 3×14, 6×7.

So we see that

$$\frac{(7a)^2 - 23(7a) + 42}{7} = \frac{(7a - 2)(7a - 21)}{7},$$

and that the second factor cancels by the denominator, giving $(7a - 2)(a - 3)$.

Having thoroughly mastered the principle, the student may omit some of the intermediate steps, and put straight down the fractional form $\frac{(7a\ \ )(7a\ \ )}{7}$ by writing a with the coefficient of a^2 as the first term of each factor in the numerator, and the coefficient of a^2 as the denominator.

We next observe that the signs of the other terms are (*a*) alike, (*b*) both negative; then we seek for two numbers whose *product* is the same as 7×6 (*i.e.*, product of the coefficient of a^2 and the last term) and whose sum is 23. We then cancel.

Example.—Factorise $24x^2 + 2x - 15$.

We at once set down $\frac{(24x\ \ )(24x\ \ )}{24}$; we notice that the signs of the other terms will be unlike, the greater being +, and find two numbers whose product is 360 (*i.e.* 24×15) and whose difference is 2. As the difference between the factors is small, we begin by trying numbers near its approximate square root 19, and at once see that $360 = 18 \times 20$. Then we complete the fraction, thus: $\frac{(24x + 20)(24x - 18)}{24}$; the first factor and denominator cancel by 4, and the second by 6, giving $(6x + 5)(4x - 3)$.

The finished work would appear thus :—

$$24x^2 + 2x - 15 = \frac{(24x + 20)(24x - 18)}{24} = (6x + 5)(4x - 3).$$

Similarly we may factorise an expression in which the terms are arranged in *ascending* powers of a common letter, *e.g.* :—

$$12 - 13x - 35x^2 = \frac{(12 - 28x)(12 + 15x)}{12} = (3 - 7x)(4 + 5x).$$

LATIN.

Both Years.—Complete the accidence to end of Irregular Verbs. Translate and retranslate 'In Catilinam,' Chap. VII.—IX.

Second Year.—Prepare in addition 'Æneid,' IX. 168–313.

FRENCH.

Both Years.—Translate 'Le Voyage autour de ma Chambre,' Chap. XV.—XXI., and re-translate passages.

Grammar of the Pronouns.—Pay special attention to the following points :—

(*a*) Conjunctive Personal Pronouns: (i) Their general position with respect to the verb; exceptions. (ii) The order of Pronouns among themselves when two or more are used with one verb. (iii) The use of **y** and **en** as personal pronouns. (4) The use of **me** and **te** *before* the verb in place of **moi** and **toi**; and *vice-versâ after* the verb.

(*b*) Disjunctive Personal Pronouns: the various cases in which they are used.

(*c*) Possessive Pronouns: circumstances which determine their gender, person, and number.

(*d*) Demonstrative Pronouns: (i) Cases in which to use the simple form **ce** (distinguish carefully from **il**). (ii) The force of the suffixes **-ci** and **-là**. (iii) Differences between **cela** (or **ceci**) and **celui-là** (or **celui-ci**).

(*e*) Relative and Interrogative Pronouns: cases in which to use the different forms.

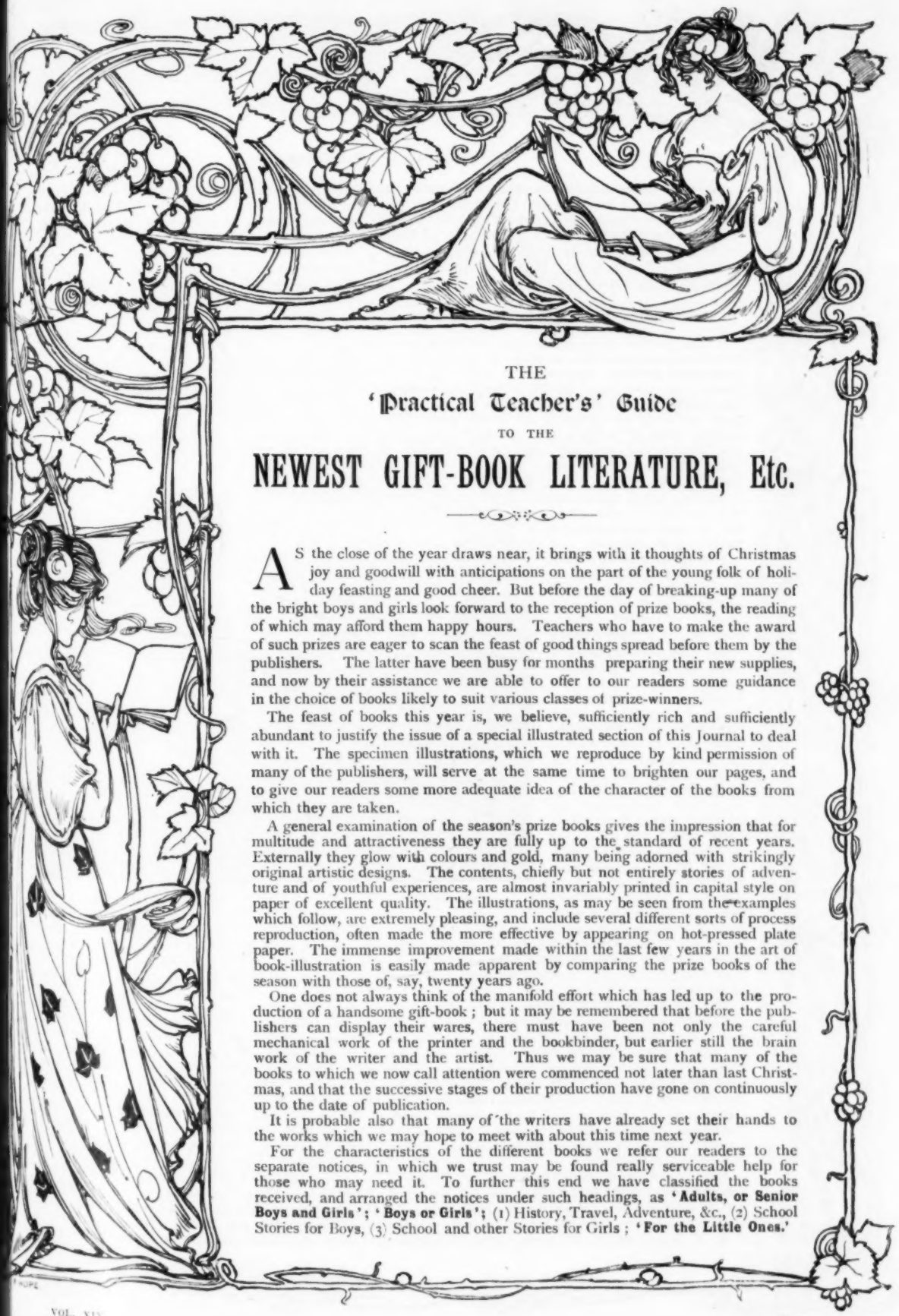
(*f*) Indefinite Pronouns: (i) Idiomatic uses of **on**. (ii) Indefinite pronouns and their related indefinite adjectives, *e.g.*, **chacun** and **chaque**. (iii) Use of 'de' with adjectives following: rien, quelque chose, rien de plus vrai, quelque chose de nouveau.

ANSWERS TO CORRESPONDENTS.

E. E. Bott.—Yes. The lines for Repetition may be selected from 'Comus.'

Perplexed.—You will find very full explanations and special illustrations in 'A New Arithmetic,' Prof. Meiklejohn's series, which was written especially for teachers. We cannot undertake to give a complete exposition of arithmetical theory in the short space at our disposal, but if you will let us know the specific points in which you find a difficulty, we will endeavour to deal with them.

(For continuation of 'Tutorial Section' see page 350.)



THE

'Practical Teacher's' Guide

TO THE

NEWEST GIFT-BOOK LITERATURE, Etc.

AS the close of the year draws near, it brings with it thoughts of Christmas joy and goodwill with anticipations on the part of the young folk of holiday feasting and good cheer. But before the day of breaking-up many of the bright boys and girls look forward to the reception of prize books, the reading of which may afford them happy hours. Teachers who have to make the award of such prizes are eager to scan the feast of good things spread before them by the publishers. The latter have been busy for months preparing their new supplies, and now by their assistance we are able to offer to our readers some guidance in the choice of books likely to suit various classes of prize-winners.

The feast of books this year is, we believe, sufficiently rich and sufficiently abundant to justify the issue of a special illustrated section of this Journal to deal with it. The specimen illustrations, which we reproduce by kind permission of many of the publishers, will serve at the same time to brighten our pages, and to give our readers some more adequate idea of the character of the books from which they are taken.

A general examination of the season's prize books gives the impression that for multitude and attractiveness they are fully up to the standard of recent years. Externally they glow with colours and gold, many being adorned with strikingly original artistic designs. The contents, chiefly but not entirely stories of adventure and of youthful experiences, are almost invariably printed in capital style on paper of excellent quality. The illustrations, as may be seen from the examples which follow, are extremely pleasing, and include several different sorts of process reproduction, often made the more effective by appearing on hot-pressed plate paper. The immense improvement made within the last few years in the art of book-illustration is easily made apparent by comparing the prize books of the season with those of, say, twenty years ago.

One does not always think of the manifold effort which has led up to the production of a handsome gift-book; but it may be remembered that before the publishers can display their wares, there must have been not only the careful mechanical work of the printer and the bookbinder, but earlier still the brain work of the writer and the artist. Thus we may be sure that many of the books to which we now call attention were commenced not later than last Christmas, and that the successive stages of their production have gone on continuously up to the date of publication.

It is probable also that many of the writers have already set their hands to the works which we may hope to meet with about this time next year.

For the characteristics of the different books we refer our readers to the separate notices, in which we trust may be found really serviceable help for those who may need it. To further this end we have classified the books received, and arranged the notices under such headings, as **'Adults, or Senior Boys and Girls'**; **'Boys or Girls'**; (1) History, Travel, Adventure, &c., (2) School Stories for Boys, (3) School and other Stories for Girls; **'For the Little Ones.'**

We must not omit to refer to one class of production which finds much favour at the Christmas and New Year season, we mean the tasteful Cards, Calendars, Toy-books, and Booklets which are annually produced in such charming variety, and with such exquisite beauty of colour-printing. Those we notice will be found decidedly worthy of attention.

New Bibles for Teachers and Students.

To the best of books is due the first place in our descriptive notices. Of no other book, it may be confidently affirmed, are so many copies given as prizes or presents as of the Holy Scriptures; and in the coming season this sacred book will doubtless hold the same preeminence as in the past. The intrinsic value of its contents is so widely recognised that it might well seem needless here to call attention to the Bible as a suitable gift-book; but we are led to do so by the timely appearance of a new issue of Bibles with special claims to the notice of teachers and students.

The publication of Bibles in this country has hitherto been practically in the hands of a small number of firms or societies. More than one of these has published editions of the Bible with explanatory 'Aids' as a sort of appendix; and the complete book thus formed has in each case been called a Teacher's Bible. Messrs. Thomas Nelson and Sons, having some months ago produced a wonderfully comprehensive and valuable **Illustrated Bible Treasury**, have now commenced the issue of a **New Series of Teachers' Bibles**, with which that work in its complete form is bound up. The result is a volume the value of which it is hardly possible to exaggerate. On the publication of the 'Bible Treasury' we felt compelled to give a very commendatory notice; but to show how admirable is the **New Teacher's Bible** with which it is included, we propose to give a brief description of some of the forms in which it appears.

'SHAKESPEARE'S TOWN AND TIMES.' (Dawbarn & Ward.) *See p.* 331.

The Illustrated Bible Treasury is a volume of 400 crown octavo pages, containing 350 illustrations, with twelve coloured maps. It includes contributions by nearly forty specialists, many of whom hold the highest rank among living Biblical scholars. We need only name a few: Dr. Sayce, Major Conder, Rendel Harris, Canon Bonney, Canon Tristram, Major-General Sir C. Wilson, K.C.B., Professors James Robertson, A. B. Davidson, Marcus Dods, and the General Editor, Dr. William Wright, of the British and Foreign Bible Society.

The information contained in the various articles is not only thoroughly trustworthy, but, for the most part, is expressed in an eminently readable form. As instances, we may refer to the charmingly written 'Life of Jesus,' by Dr. W. Ewing, and Sir Charles Wilson's account of the 'Travels of St. Paul.' The illustrations are not of the fanciful kind, but such as help the student to an intelligent apprehension of many details.

One of the most useful features is a Combined Concordance, which includes a Subject-Index and an Index of Proper Names, and supplies references to all the important differences between the Revised and Authorised Versions.

It might be thought that the inclusion of such a work in the same covers with the full text of the Bible with references would make an unwieldy volume; but this is not the case, for the whole is printed on the specially made **'Royal' India Paper**, thin, tough, smooth, and opaque, which secures lightness and convenience of form, as well as extremely clear impressions of the letterpress and illustrations. Thus, in spite of its almost eighteen hundred pages, the Teacher's Bible is remarkably handy. The minion 16mo. edition of the complete work is only $1\frac{5}{8}$ inches in thickness. A useful innovation is the indication in the list of books of the page on which each begins.

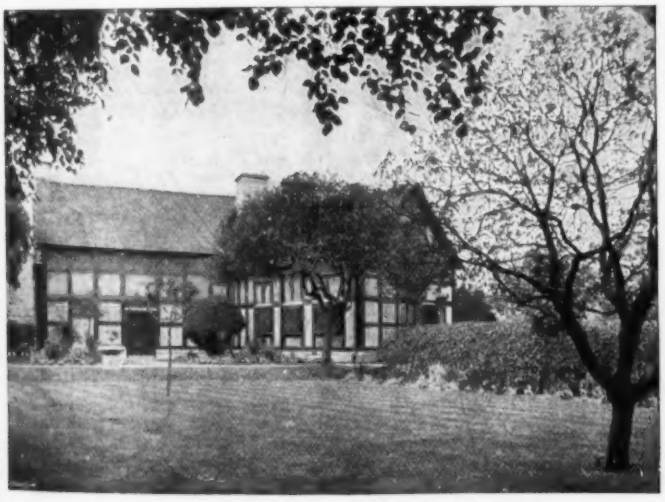
It is published in several different forms and at varying prices to suit different tastes and purses. There are four entirely distinct editions dependent on the size of type and size of page. Ruby 24mo., page $5\frac{3}{8}$ by 4 inches; Minion 16mo., page $6\frac{3}{4}$ by $4\frac{1}{4}$ inches; Minion 8vo., page $7\frac{3}{4}$ by $5\frac{1}{4}$ inches; and Long Primer 8vo., page 8 by $5\frac{1}{2}$ inches.

There are also various styles of binding, from antique cloth and French Morocco limp to the best Levant Morocco. The best quality Bibles in both large and small sizes are exquisite examples of workmanship, and one can hardly imagine any book more beautifully produced and at the same time so suitable for regular use. The substantial binding in Yapp style safely preserves the leaves, which have rounded corners and edges red under gilt, for which the best

English gold is used. The covers are lined with best calf leather.

Messrs. Nelson also publish editions of the Bible text alone, or text with references, and text with references and indexed atlas.

Another volume which deserves special mention in connection with this series is the **Illustrated New Testament**. This is a beautiful book of 576 pages, clearly printed in long primer type, and embellished with two hundred charming illustrations. These represent Bible scenes and sites, and are for the most part reproduced from photographs by Bonfils, Thevoz, Mason Good, and others. Neatly and strongly bound in extra cloth limp, with red edges, the price is only half-a-crown, and in French morocco, with red edges under gold, four and six-pence. It forms indeed an ideal prize for the Sunday-school.



'SHAKESPEARE'S TOWN AND TIMES.' (Dawbarn & Ward.)

ADULTS, OR SENIOR BOYS & GIRLS.

Concerning Teddy. By Mrs. Murray Hickson. (James Bowden.) A series of episodes occurring during Teddy's summer holidays are most delightfully sketched in this volume. Teddy is a typical school-boy of the well-to-do class, with a good deal of originality in his views of things. The author enters with sympathy into these views, and sets before us Teddy's relations with his brothers and his friends with charming delicacy of observation and of style, and with exquisite humour. The book, however, is more likely to be appreciated by 'grown-ups' than by children. Its insight into 'a boy's thoughts' suggests serious reflections, and appeals especially to teachers and others who take an interest in child-study.

Shakespeare's Town and Times. By H. Snowden Ward and Catherine Weed Ward. (Dawbarn & Ward, Limited.) The authors of this book have set themselves the simple task—'to write in plain words the tale of Shakespeare's life, to picture what remain to us of the scenes which Shakespeare saw.' In this task they appear to us to have admirably succeeded, and the result is an extremely readable and attractive volume. The facts known to us of Shakespeare's life and family history are plainly set forth, and to these are added a large amount of information on his home surroundings and on the means taken to honour his memory in Stratford and its neighbourhood. The work is illustrated by nearly one hundred and twenty 'photograms' or reproductions from photographs, and as the authors are editors of 'The Photogram,' a high-class photographic journal, and the pictures have the advantage of being presented on an extremely suitable surface, one need not wonder that these illustrations are remarkably effective. We have been kindly allowed to transfer two of them to our pages, and we have chosen as of special interest, the Old School Buildings, and the rear view of the Birth-house. The work is issued in handsome quarto form.

There are no volumes issued during this gift book season more worthy of special attention than the two selected by Messrs. Dent & Co. from their many artistic productions. **Ingoldsby Legends**, and Thackeray's **Henry Esmond** are the two before us from the series of 'Illustrated Romances,' etc. The extraordinary attraction of the first lies in the merit and abundance of its quaint illustrations. The volume contains over a hundred beautifully executed designs, of which a dozen are full pages in colours. It is a positive treat to go over 'Ingoldsby' again with so much pictorial embellishment. Of 'Henry Esmond' we cannot do better than quote the following well chosen words from Walter Jerrold's Introduction: 'A popular living writer of fiction on being asked to name his favourite novelist and that novelist's greatest work, replied indirectly but eloquently with the statement that he was in the habit of re-reading Thackeray's 'Esmond' once every year. This testimony to the perennial freshness and excellence of the book would find many readers to endorse it, for there seems a fair consensus of opinion among capable critics that this delightful romance is not only the best which Thackeray has left us, but that it is one of the very finest of books of its kind which the world possesses."

Both volumes are perfectly printed in old-faced type, on good paper with rough edges, thoroughly well and tastefully bound. From every standpoint they are unique specimens of book production, and no Prize Book collection should be made without the inclusion of these handsome and cheap editions.

Table Talk with Young Men. W. J. Dawson. (Hodder & Stoughton). Mr. Dawson's 'Table Talk' is eminently readable, gives much information, and contains sound advice. In 285 pp. he discourses to young men on most subjects in and out of philosophy—politics excepted. Rational treatment of the body, cultivation of the intellect, our duties and responsibilities to the state as well as to ourselves, what to read and how to do it, poetry and prose, the ethics of religion and science, etc., etc., all contribute, under Mr. Dawson's facile pen, to the store of information he wishes to impart. The author is a man of wide reading, and brings most writers, ancient and modern, to his aid. We may not always agree with his conclusions, but at all events he argues with much skill and goes to the point without evasion. The chapters on 'Knowledge for its Own Sake,' 'Christianity and Love for Christ,' and on the 'Discipline of Self-Culture,' are particularly worthy of

study. He shows that science and religion are not in opposition, and, like Kingsley—of whom he speaks with great admiration—he brings science and its votaries to the aid of religion. The 'Worship of Humanity' receives more contempt than consideration at his hands, as being puerile and farcical in comparison with the worship of God. Mr. Dawson does not wish his book to be judged as a volume of essays, but rather as discursive and occasional jottings and opinions expressed in his teaching and conversation. As such they are the result of much experience and wide knowledge. The author is a robust and epigrammatic writer, but also occasionally dogmatic. To wit, when speaking of Napoleon, he says: 'There can be only one opinion of his military capacity. He was the greatest general who ever lived.' Again, 'Wellington was out-generalled at every point by his rival.' 'Of military strategy on the part of Wellington there was no sign.' We cannot discuss these matters here, but the assertions are sweeping. One other example: 'Tennyson was not in any sense an international poet.' As the poet of the ideal, we venture to think he will probably become common to all nations. However, we must thank Mr. Dawson for such passages as 'It is the shallow nature which does wrong, and feels the shame of the exposure rather than the shamefulness of the act.' And 'In a country like ours Christianity is the soul that moves behind all the body of laws, government, custom, literature, life; we can as little escape it as we can escape the atmosphere we breathe.'

'INGOLDSBY LEGENDS.' (J. M. Dent & Co.) *See p. 331.*

The Day's Work. By Rudyard Kipling. (Macmillan & Co.) We have long been accustomed to think of Kipling as the Cecil Rhodes of English literature, and while we cannot hope that the idea is an original one, we beg to disclaim for it any higher authority than our own; if any one has expressed the same idea, we apologize in advance for the unconscious plagiarism. The parallel between our two great men is sufficiently obvious. Where other writers have seen nothing at all, or only a dark unexplored waste, Kipling has found continents rich with mines of purest ore, and he has vigorously set himself to 'paint them red,' not in the American sense of the term, but in the sense of claiming them for the empire of English literature. If in some cases he has made a raid with more daring than success, or annexed a district here and there whose hinterlands are not promising in 'pay dirt,' he has nevertheless pushed forward the literary frontiers at a rate not unworthy of the comparison we have ventured to make. Already his success is great enough to have secured him various imitators: men who have not realized that in this case to imitate is to court defeat. The work before us which has suggested these thoughts is a collection of a 'baker's dozen' of short tales. Some of them, such as 'The Tomb of his Ancestors' and 'The Maltese Cat' we have read before, and have enjoyed all the more on that account, for one does not exhaust his Kipling in one reading. There are others in the volume which continue his explorations in unknown India. As a picture of famine work in that peninsula, 'William the Conqueror' is unique in its power of graphic painting, with a light of tender romance playing over the darker shadows. 'The Bridge Builders' on the other hand breaks off into a fantasia of jungle beasts and native gods such as Kipling alone can give us, and which makes us realize our stupendous ignorance of that empire which has up till his time been 'painted red' only in the geographical sense. Several of the stories deal with Kipling's newer conquests, his representations of American life and character, not of men only, but of horses and locomotives as well, and in these the prose form does not disguise the poetical insight which he displays equally well in verse when it suits his fancy. The Scotch engineer, of whom Macandrew will stand as the apotheosis, appears in a specially enjoyable guise in 'Bread upon the Waters,' and there are other tales such as 'The Devil and the Deep Sea,' and 'The Ship that Found

herself,' which, to sum up their excellences in one phrase, could only have been written by Kipling. The book is a thoroughly virile and enjoyable one, and, if it does not increase, will at least maintain the author's high reputation.

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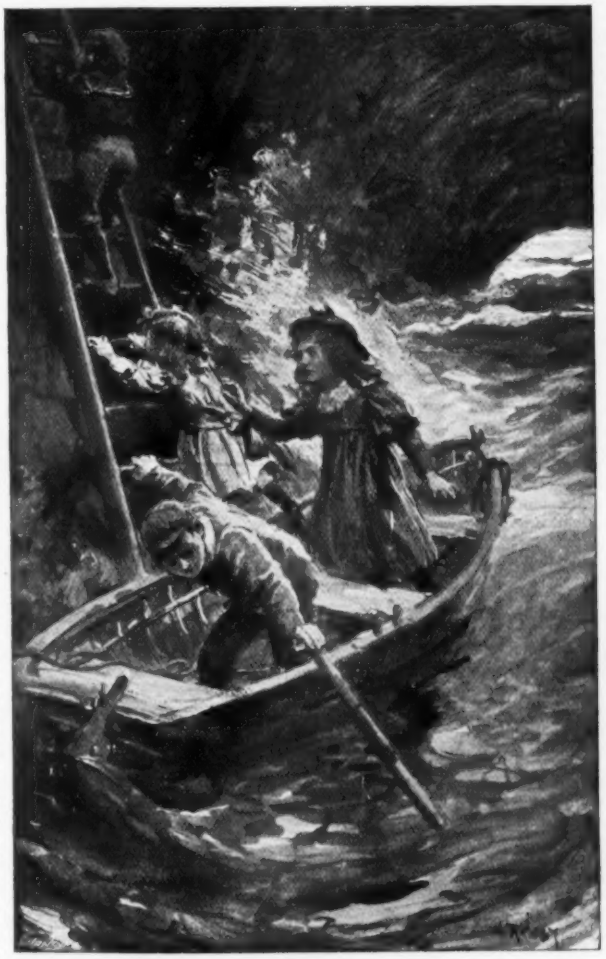
BOYS OR GIRLS.

I. History, Travel, Adventure, & other Stories.

Courage, True Hearts. By Gordon Stables, M.D., R.N. (Blackie & Son.) This is a capital story of three boys who in the search of fortune find themselves, after leaving Scotland and London, in various parts of the world. In the Indian Ocean they are wrecked; in Africa they see savages and pick up diamonds and nuggets; and when they have barely escaped with their lives by land and by sea, they take to the air in a balloon. They are the sort of boys personally that other boys approve, because they are not a bit too good. They quarrel sometimes and call names, and even once or twice tricked the natives abroad; but they grow staid as they grow older, and finally give up adventure for quiet happiness at home.



'A DREADFUL MISTAKE.' (Blackie & Son.)

A Dreadful Mistake. By Geraldine Mockler. (Blackie & Son.) A very readable book. A family of four, two boys and two girls, go on a long visit to a great aunt. They miss their train, which begins their troubles; they are so tender-hearted that they cry over cooked chickens before eating them; they disobey their much-suffering relative, and consequently are nearly boat-wrecked, and only escape to go through other dangers in a smugglers' cave. Bravery is the good quality of the boys, and prevents the fatal effects their disobedience might have caused. Finally they mend their ways, and their visit ceases to be a dreadful mistake.

Twin Pickles: a Story of two Australian Children. By Ellen Campbell. (Blackie & Son.) This is emphatically a jolly story, and gives a lively picture of colonial life. The 'Pickles' leave their baby sister by an ant-heap, when they mean to take care of her; tumble into a ditch when they have ridden out to meet the bishop in style; make great mistakes in undertaking the charge of a nestful of eggs to give the hen a holiday; and nearly blow themselves to pieces with an old pistol. But all ends well, an attack of croup included. The picture of the twins with their new pony is capital.

The Bonded Three. By Bessie Marchant. (Blackie & Son.) Triplets are the heroes of this tale. They are the children of an Indian tea-planter—two girls and a boy—and have the misfortune to be living in the midst of a native revolt. According to Hindoo tradition, *trimurti* (triplets) are approved of the gods, and this belief saves them from the great danger which their magic number had also brought upon them. The story is full of interest from beginning to end, and is sure to be a favourite with both boys and girls. There are four good illustrations.

Uncle Tom's Cabin. By Harriet Beecher Stowe. (James Bowden). We are pleased to welcome this new edition of an old favourite. 'Tis a book for all time, and must be read by everybody everywhere. Adults, in recalling the indignation, the tears, and the laughter of their early years on reading this famous story, will envy the boy or girl into whose hands the volume is placed for the first time. Well bound and clearly printed, with a number of full-page illustrations by Charles Copeland, this book is one to make any scholar happy to get.

O'er Tartar Deserts. By David Ker. (W. & R. Chambers.) This is an interesting and educative boys' story. The author, under cover of a fairly-well constructed plot, gives us a graphic insight into some of the lesser known parts of the vast domains of the Czar. The story opens at Moscow, where the English heroes have the good fortune of being introduced to Alexander II. The scene next shifts to Borjom, the Caucasian home of Count Bulatoff, the great Russian explorer. Detailed descriptions of the customs and modes of travelling in the land of the Turkoman follow. The thrilling adventures culminate in the capture of Henry and Mary by Albanian brigands. Their rescue is brought about by their fathers, Count Bulatoff and Mr. Archer. The book is well illustrated and printed, and should be

sought after as an acceptable prize book during the coming season.

Our Vow. By E. L. Haverfield. (T. Nelson & Sons.) This is a very nice story, told with considerable humour, of a boy and a girl who were reclaimed from their wildness and wilfulness by the gentle influence of Cousin Evelyn. The love of being in mischief had taken a firm hold of these youngsters, and for some time Cousin Evelyn had her hands full. The boy gave in first, but the girl showed more pertinacity. Finally, however, she too succumbed to Cousin Evelyn's winning ways, and a permanent peace was established in the household.

Blue Jackets; or, the Log of the Clipper 'Teaser.' By G. Manville Fenn. Illustrated by C. J. Staniland, R.I. (Griffith, Farran, Browne & Co., Limited). One of the best books we have read this season. The *Teaser* has been sent to the coast of China to aid in putting down pirates. Herrick, Barkins, and Smith are middies on board the clipper. They go ashore at Nyho, and narrowly escape ill-treatment from the inhabitants of the place. They are rescued by the help of Ching, a Chinaman who speaks English, and with their protector make good their return to the ship. We can heartily recommend this book to our young readers.

Three Boys; or, the Chiefs of the Clan Mackhai. By G. Manville Fenn. Illustrated by Stanley Berkeley. (Griffith, Farran, Browne & Co., Limited.) Max Blande, the only son of a London solicitor, is sent on a visit of some duration to Dunroe, the seat of the head of the Clan Mackhai, where Kenneth, the chieftain's son, and Scoodrach, the young gillie, become his companions in many an adventure in one of the most retired and picturesque parts of the West Coast. The hardy young Highlanders at first set down the delicate and tenderly-nurtured town-boy as a coward or at least a milksop, but a better acquaintance with him proves him to possess qualities which win their respect, and which knit between him and the chieftain's son a friendship destined to last their lives. The Mackhai himself is, however, well aware for what purpose his young visitor has been sent. Mr. Blande, Max's father, holds over the Mackhai estates a mortgage, which he is well aware the Chief cannot redeem, and he has sent down his son that he may learn to live the life of a gentleman on an estate which will shortly be his own. Max learns the truth when his father forecloses and requests him by letter to remain and keep an eye on the property. The boy has, however, the instincts of a gentleman, and, rather than play such an ignoble part, leaves Dunroe at once to tramp over the moors to Glasgow. Scoodrach's blind fidelity to his young master leads him to misdirect Max, who loses his way, falls into the hands of rogues who are engaged in illicit distillation, and is in danger of losing his life, when he is rescued by the Chief and his son, who have become aware of Scoodrach's scoundrelly trick. The Chief discovers the noble nature of his young visitor, whom he had hitherto treated with a haughty reserve, and learns to love him as much as his son does. The story now hastens rapidly to its *dénoûment*. Mr. Blande takes possession of Dunroe, but does not live long to enjoy it. The estate comes into Max's hands, and he loses no time in restoring it to the Mackhais. The story is a healthy and interesting one, full of incident, and told as only a master in the art of writing tales for boys could tell it.

Middy and Ensign: or, the Jungle Station. A tale of the Malay Peninsula. By G. Manville Fenn. (Griffith, Farran, Browne & Co., Limited.) The scene opens on board the *Startler*, which is carrying to Campong Allee, in the Malay Peninsula, the British Resident and his escort. The Resident was to be the helper and adviser of Rajah Hamet, who had sought the protection of the British Government against the inimical petty Rajahs of the neighbourhood, and the corvette is to remain for nine months in the river, until the Resident is firmly fixed in his post. Bob Roberts, the middy, and Tom Long, the ensign, are, in their own persons, examples of the rivalry continually existing between the Army and Navy. Despite the constant quarrels between them, the two youths have at heart a liking for each other, which needs only a parti-

'OUR VOW.' (T. Nelson & Sons.)

cipation in peril, with the opportunities it presents for noble and unselfish deeds, to develop into a firm friendship. The opportunities present themselves, for, after punishing the enemy of the Rajah whom they had come to protect, the latter turns traitor. Under pretence of a grand hunting party, he decoys the Resident and his protectors far into the forest, where he intends to drug and then to murder them. Space does not permit us even to sketch the stirring adventures connected with the attacks on the Residency and on the corvette. Suffice it to say that British pluck defeats the open attacks and the treachery of the Rajah. We have read the tale with much pleasure. It is lively and interesting throughout, and is the wrong sort of book for a boy to pick up when severer duties claim his attention.

The Young Franc-Tireurs and their Adventures in the Franco-Prussian War. By G. A. Henty. (Griffith, Farran, Browne & Co., Limited.) Captain Barclay, a retired English officer, is living at Dijon, where he marries Mdlle. Duburg. At the outbreak of the war of 1870-71, his sons Ralph and Percy are respectively sixteen and fifteen years of age. Carried away by the martial fervour of the time, they join a corps of Francs-Tireurs, where they distinguish themselves for their bravery, and, by their knowledge of German, are able to give important information as to the enemy's plans. For their good service they receive commissions in the regular army; are taken prisoners and deported to Mayence, whence they escape to France by way of Luxemburg and Brussels. Betaking themselves to Tours, they are introduced to Gambetta, who entrusts to them the perilous task of carrying despatches to the beleaguered capital. Disguised as German Jews, they make the attempt successfully. For their bravery, they are promoted to the rank of Captain and receive the Legion of Honour. Escaping from Paris by balloon, they participate in the last struggles of their adopted country, and return with their father after the war to England. The book is crammed full of adventure and hair-breadth escapes, and as such is certain to be a favourite with boys, who will get a very good idea of the history of one of the greatest conflicts of modern times in the most attractive manner. The phraseology of the book is at times somewhat loose and ungrammatical, and might be improved when another edition is issued. The French also needs correction. *Francs-tireurs* occurs every time without the plural sign to the adjective, and a Parisian would not recognise some of the French quotations as being in his own language. *Vive les Franc-tireurs du Dijon* is a peculiarly atrocious example.

'THE YOUNG FRANC-TIREURS.' (Griffith, Farran, Browne & Co.)

A Race for Life. By Fred Wishaw. (Griffith, Farran, Browne & Co., Ltd.) Mr. Wishaw has used the idea of a cycle of tales with capital effect. A party of sportsmen, who are passing some nights under the pines in Finland waiting for the capercailzie cocks to commence their tournaments, agree to while away the time by relating in turn the most remarkable escape which they have experienced. The prize is to be the best place in the shooting, and those who have had no memorable adventure have to invent something plausible or pay the expenses of the party for one night. Under such conditions, with such a company, and to the accompaniment of the wind in the tree tops, it is not surprising that the tales are 'fearful and wonderful.' Escapes from wolves, bears, lions, tigers, a burning theatre, a blazing naphtha ship, a poacher, and a sudden flood, form a volume of enthralling interest, which to any boy would be irresistible. One narrator told such a tale of a 'Race for Life,' 'with the mudguard of his bicycle scratching the nose of a wolf,' as a listener puts it, that he is compelled to tell another. When the voting takes place, each votes for himself, and as the man who told two tales claims and is allowed two votes, he won. In all respects—contents, illustrations, and binding—a splendid book for boys.

Clutterbuck's Treasure; or, Neck for Neck for £100,000. By Fred Wishaw. (Griffith, Farran, Browne & Co., Limited.) This is a fascinating tale with a novel and ingenious plot. The hero, by the sudden ruin and death of his father, is left nearly penniless. He happens to rescue an eccentric old miser from robbers, and for this is made a

possible heir to his fortune. 'Possible' only—for the old man, who had a strong dislike to his lazy heirs, had arranged that no one should obtain possession of his money without doing something for it. The will directs that the fortune shall fall to the first of five competitors who get to the treasure which is buried in South Africa. Explicit directions are given as to the locality and to the spot which is pegged out. The hero, accompanied by a friend, enters for the race and wins the first heat after various escapes from attempted murder (by three other competitors) and various wild animals; but the prize is merely a letter of fresh directions on a similar quest to an island in the Gulf of Finland. Two only start in this heat, for one of the possible starters is killed by a lion, and another shot by the villain who had stolen the information in the letter. The hero wins this heat also, and obtains a crude painting of old Clutterbuck and another letter, which sent him off this time to London. The race in the third heat is a terrible struggle, in which the villain uses every means to delay his more fortunate rival. But in the end, by the aid of the old painting, the money is found. The villain is detected in an attempt to rob the treasure and goes to Dartmoor on a visit, and all ends happily. This is the best tale for boys which Mr. Wishaw has produced, and will become immensely popular.

'IN THE YELLOW SEA.' (Griffith, Farran, Browne & Co.)

In the Yellow Sea. By Henry Frith. (Griffith, Farran, Browne & Co., Limited.) The tale is supposed to be founded on the experiences of the writer's nephew in the late war between China and Japan. Young Julius has a taste for the sea and a longing to enter the British Navy. This he is unable to gratify, as his eyesight does not satisfy the examining doctor. In one of his boating trips he is caught in a squall and rescued by an outward-bound vessel, on which, something like Harvey Cheyne in Kipling's tale, he finds himself an unwilling passenger. Like the millionaire's son in 'Captain Courageous,' he is inclined to be somewhat bounceable, but he speedily gets his pertness knocked out of him, and is made into a sailor by liberal applications of a rope's end, administered whenever necessary. The *Fêng Shui* arrives in China just about the time of the complications, which ultimately resulted in war. After an adventure, in which he loses his ship for some time, Julius rejoins her at Shanghai, whence they embark Chinese soldiers for Corea. They are stopped by a Japanese warship, after a fight rendered necessary by the refusal of the Chinese soldiers to surrender. The young Englishman witnesses on board the Japanese ship a naval engagement, in which the Chinese are defeated. Julius is put on shore as a spy, and passes through thrilling adventures, and sees some exciting scenes whilst making his way across the area of the conflict between the hostile armies. At length he reaches a treaty port, where he meets once more with friends. Mr. Frith knows how to tell a story, and has exercised great judgment in selecting and stringing together incidents which give a good idea of the great conflict in the East. The language of the book is, however, extremely slipshod, and there are many examples of absolutely incorrect English: 'There was no hammocks slung'; 'whom I now learned was attached to the army staff'; 'their eyes being nearly closed altogether'; 'Considerating which path I had best pursue'; 'this . . . must end in clearing away the nation from the earth which advocates and practises such barbarities'; 'we were at Hong Kong in the year 1894, a place I always liked'; 'Whom of those hundreds . . . thought of the massacred Chinese?' are only a few examples of the faulty English of this book.

A Pirate of the Caribees. By Harry Collingwood. (Griffith, Farran, Browne & Co., Limited.) There is a never failing supply of interest and adventure in the doings of the buccaneers of the Spanish main, who possess a singular fascination for all boys, and this tale may take rank with any that have been written on the subject. After a fight with a couple of French frigates the ship in which the hero serves founders, and the crew have to take to the boats. By the clever capture of a small schooner a few of them reach Jamaica, the greater number, however, being lost. Placed in command of a small vessel, the hero discovers the retreat of a renowned pirate, burns his houses, dismantles his forfications, and carries off his treasures. For this he is kidnapped and placed on a felucca to be handed over to the pirate for torture. He escapes, however, and after being wrecked, tossed about on a raft, and picked up by a slaver, by a fortunate chance he is enabled to return to Jamaica. Once more in com-

'CUCKOO CLOCK.' (Macmillan & Co.'s Illustrated Prize Library.) *See p.* 338.

mand, he receives a challenge to the death from the pirate, accepts it, and after a severe tussle succeeds in sinking the vessel of the rascal who has long done such injury to passing traders. There is no boy who will not read the book with the keenest interest and pleasure, and without acquiring anything detrimental, for Mr. Collingwood properly abstains from the repulsive details which are often to be found in books dealing with pirates and their ways. We have much pleasure in recommending it to our readers as a first-rate prize for any boy.

An Ocean Chase. By Harry Collingwood. (Griffith, Farran, Browne & Co., Limited.) Mr. Collingwood, like Mr. Clark Russell, seeks and finds inspiration from life on the sea, and can tell a yarn which does not flag in interest from the first word to the last. This is a tale which is hardly inferior to 'The Wreck of the Grosvenor,' and, though appearing as a tale for boys, will be read with interest by those who have long lost any claim to that title. The *fiancée* of the man who tells the tale is abducted through the agency of a dishonest guardian, and carried off on a yacht. Her lover picks up the trail and finds the yacht is making for the Straits of Magellan. Following on his own schooner he starts the chase, and after being delayed by a calm, blown out of his course by a hurricane, detained on one occasion to rescue the crew of a sinking ship, and on another to settle accounts with a pirate, and when in sight of his prey by running aground in the Straits and sustaining an attack by savages, helped by information from passing ships, from a sailor whom he rescued, and a derelict which supplies him with a new mast when he so badly needs it, he finally comes up with the yacht in the Pacific, and is just in time to rescue his sweetheart before the vessel from which she is taken is caught by a hurricane, unprepared, and founders. In every respect an interesting and instructive tale.

His Big Opportunity. By Amy Le Feuvre. (Hodder & Stoughton.) Two small boys want to be 'big,' and as a first step to greatness they bestow sixpence on a poor man. Their second step is to break into a cottage to relieve another poor man in consumption; he, however, takes them for burglars, and will have none of their help, and is very angry at their upsetting his jugs of milk. But the 'big opportunity' comes at last, when they are able to rescue a poor old man lost in a cave, and is repeated when, in gratitude to a big boy named Rob, who helped them out of a great difficulty, they find him a home in theirs. The rest of the tale is in keeping with this, and the whole will greatly please boys of eleven years of age and upwards. The illustrations are good.

Brave Hearts and True. By M. Douglas. (Jarrold & Sons.) The contents of this inspiriting book are fully explained by the sub-title, 'Stirring Stories of Noble Lives.' The story of Florence Nightingale is told in a charming way, and is sure to please elder girls; whilst the several heroes who follow will equally attract elder boys. There is the Pioneer Bishop, the Great Discoverer, the Man who Saved Europe, the Prince of Philanthropists, and the Soldier-Martyr of Khartoum. Before the name of each is a title which is a key to the personality, and embedded in each story is an anecdote of child-life giving the germ-form of the quality which afterwards distinguished the hero. Gordon's conduct with the big bully at the Cadets' College will specially interest the boy reader.

Three Children of Galilee. A Life of Christ for Young People. By John Gordon. (Jarrold & Sons.) The Life is taken from the four Gospels, and is told in the

'CUCKOO CLOCK.' (Macmillan & Co.) *See p.* 338.

language of to-day. The story begins with the year 27 A.D., and the locality is Capernaum. A wedding-party, in which are Solomon, the son of Chuza, Herod's steward, and Titus, a young Roman, the son of the centurion in command of the garrison close by, and Miriam, the daughter of Jairus, are about to proceed in a pleasure boat to Cana of Galilee. In due time they arrive there, and are present at the miracle of turning water into wine. This greatly impresses the youthful minds of the three, and the rest of their lives is always influenced by it. The book in detail as well as in its main features is exceedingly interesting, for the habits and customs of the people in the time of Christ, as well as the topography of the country, are well described. There are over one hundred illustrations, and many of them are exceedingly beautiful.

The Expedition of Captain Flick: A Story of Adventure. By Fergus Hume. (Jarrold & Sons.) We have here a tale of exciting adventures in the search of a mysterious island called Isk in the Indian Ocean, and the endeavour of Captain Flick to obtain possession of an ancient Greek statue which is worshipped in that island. Captain Flick picks up one of the natives of this island, and from the tattoo marks on his body and the tale of the native he gathers that the island is populated by a race of negroes small in stature, under the rule of a white king, a descendant of refugees from Greece, who brought the statue with them. When the white king desires a wife the natives are sent to Greece to purchase or steal one for him, as the daughters born on the island must become priestesses in the temple. This results in a beautiful English maiden being stolen from the yacht commanded by Captain Flick, while he is waiting for the expedition from Isk to come to Greece for a wife, in the expectation of following them to their mysterious island. The natives elude Captain Flick, but after a time he discovers the island and endeavours to rescue the English maiden and procure the statue. The adventures are very exciting until the final climax, when the island is destroyed by a volcanic eruption. Captain Flick is disappointed in his attempt to get the statue, but the conclusion is interesting and pretty, and results in the happiness of the owner of the yacht and one of the priestesses, who is substituted for the statue. It is a very attractive book, and at times is very fascinating. It is well printed and bound, and has some good illustrations.

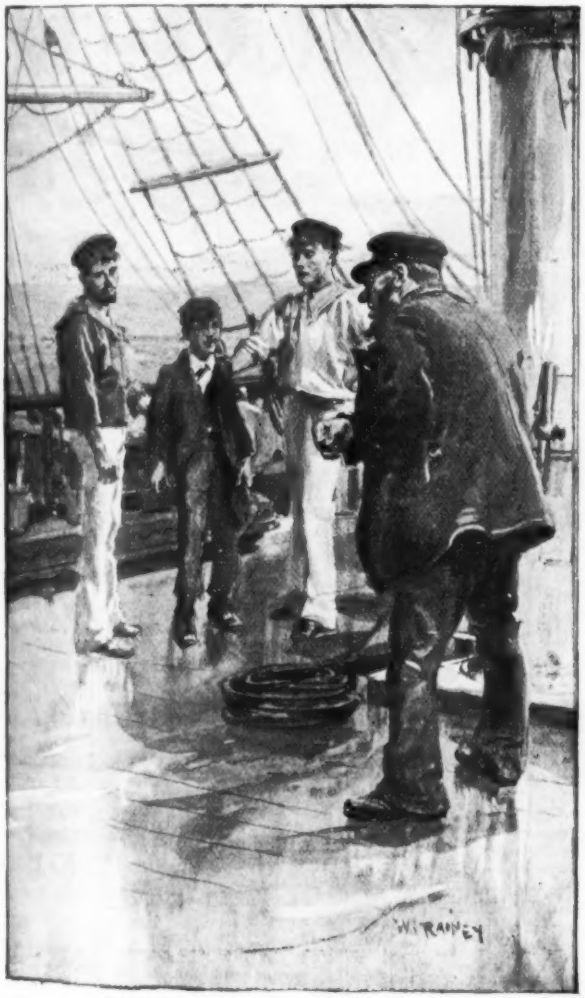
'PATRIOTS OF PALESTINE.' (National Society's Depository.) *See p.* 339

Macmillan's Illustrated Prize Library. This neat and inexpensive series of books promises to become a wonderful storehouse of juvenile literature of all varieties. The appearance of **Tom Brown's School Days** will give a new popularity to a book which will not soon become old—a book which every boy will be the better for reading thoroughly. **Handy Andy** is another old favourite whose popularity rests on a solid and well-proved foundation, though of a somewhat different character from that on which rests the Rugby boy's title to fame. Representing the moral tale, which despite certain modern evidences to the contrary, will probably survive the immoral in the long run, we have **Lazy Lawrence and other Stories,** by Miss Edgeworth, which young readers will thoroughly enjoy. Of the class which may be broadly described as the modern fairy story, there are three before us, Mrs. Molesworth's **The Cuckoo Clock,** Canon Atkinson's **The Last of the Giant Killers,** and Mrs. Hugh Fraser's **The Brown Ambassador.** All three contain charming scenes and are sure to please the lucky youngsters who are now so lavishly provided with their favourite literary fare. **The Adventures of Hajji Baba of Ispahan,** by James Morier, with an introduction by Lord Curzon, has also been included in the series, and though from some aspects less suited for boys' reading, is of great value for the minutely detailed pictures of Oriental life, in which it rivals the classical Arabian Nights. All the volumes are illustrated, and many of the drawings by Walter Crane and others, are of high excellence.

Stories from American History. Buccaneers and Pirates of our Coasts. By Frank R. Stockton. (Macmillan & Co.) Mr. Stockton has dealt in a masterly fashion with his subject. To those who like books of this type, the histories of such wonderful individuals as Bartholemy Portuguez and L'Olonnois the Cruel will prove very attractive. The most valuable feature of the book, we think, is the interesting and scholarly way in which the origin and development of buccaneering and piracy are traced. The author has done a good thing in

exposing the questionable practices of men like Columbus and Drake. As a history of piracy the book deserves nothing but praise. The printing and illustrations are worthy of the publishers and artists.

Stories from Lowly Life. By C. M. Duppa. Illustrated by Louis Wain. (Macmillan & Co.) This is a first-rate and original book, consisting of seven studies of individual pet animals; viz., a wood-mouse, a fox terrier, a pointer, a bullfinch, a black and tan terrier, a dormouse, and a thorough-bred mare. Perhaps the accounts of the less familiar animals are the most fascinating. Here is part of the description of the rearing of an infant foundling wood-mouse. 'Lodging was thus satisfactorily arranged; board was a far more difficult matter. He was too young to lap milk from a saucer, too small to take it from a bottle after the fashion of pet lambs, and apparently too fastidious to relish it from a camel's hair brush. We were reduced to letting the milk fall drop by drop on to his mouth from the brush; about half would be swallowed, and the rest trickled down his chin and paws. He had been brought into the house at 4 p.m., and by eight we began to despair of feeding him, particularly as he was evidently growing weaker, when, fortunately, he discovered how to feed himself.' This was by licking the milk out of the cracks of the hand that held him. 'Naturally, this process was a very messy one; and the fur as it grew became very sticky to the great annoyance of its owner, who, blind and helpless as he was, did his utmost to keep clean. It was touching and yet ludicrous to see that pink and grey morsel, still blind, sitting bolt upright, and trying with might and main to wash his back! . . . Every now and then he would collapse and roll over and then start afresh.' On the third morning the waif nearly died because his morning meal was delayed so late as 5.30 a.m.! But in the end he throve; nibbled his way through every wooden obstacle till a cage of zinc was specially made for him; amused the whole family when let loose, by collecting such miscellaneous articles as thimbles, rings, and even a sovereign, hiding them in his cage; made a pet of a china rabbit till he tired of its stiffness; piled up hoards against bad weather, had battles with a dormouse; and finally died 'from over-indulgence in cherry stone kernels.' Don, the pointer, might well be called 'a great glutton,' since he 'wandered into a scullery one day, and after eating up the dinner that was waiting for two dogs and four cats, calmly proceeded to empty the small bucket of wash which had been put aside for the pigs.' Dick, the bullfinch, 'came as regularly as the teapot to breakfast,' and after attacking the butter would wipe his bill on the clock. The description of a dormouse hunt in January is charming; as is that of a spirited mare who never forgot or forgave the mistake of a young lady friend in offering her a potato *too hot*. The whole book is full of delicate and sympathetic observation, and the illustrations are spirited. It is a book to class with Mrs. Brightwen's 'Wild Nature Won by Kindness,' and Miss Benson's 'Subject to Vanity'; and if young teachers would consult such books in preparing object lessons and natural history lessons, and leave alone anatomy and the preparation of beef and leather, it would be better for the children.



'THE UNCHARTED ISLAND.' (T. Nelson & Sons.) *See p. 341.*

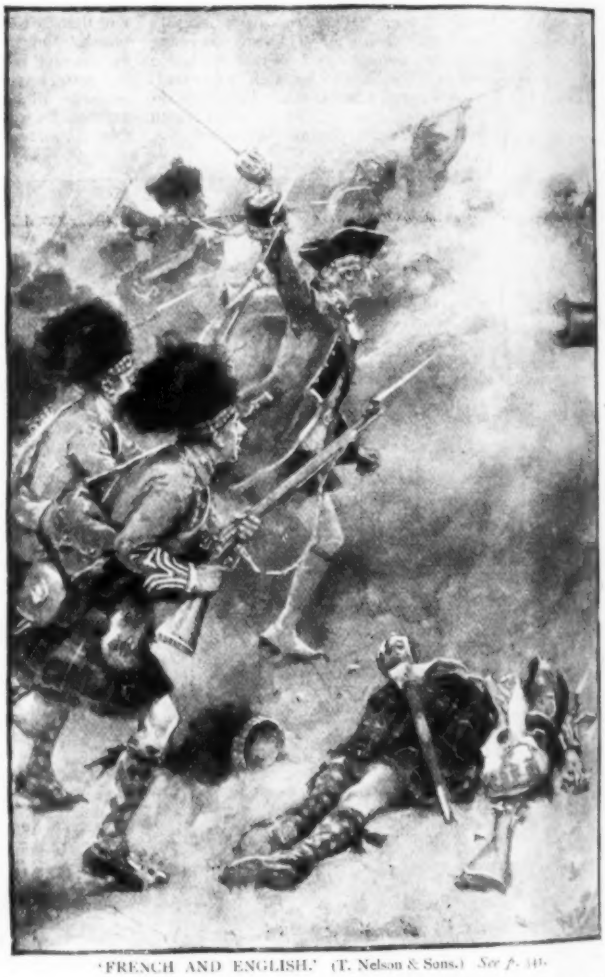
The Patriots of Palestine. By C. M. Yonge. (The National Society's Depository). In the opening period of her preface, Miss Yonge says: 'Our young readers may, perhaps, be disappointed that more individual story is not dwelt upon.' We think that very few readers, indeed—young or old—will be disappointed in any degree after reading the 'Patriots of Palestine.' The story centres chiefly round the lives of three families: those of the brothers Eliakim and Nathan, and that of Mattathias the Priest; all of the true Levitical blood. Judas Maccabeus was the eldest son of Mattathias, and led the opposition against the hosts of Antiochus Epiphanes the Syrian. Nathan was a rich merchant trading between Egypt and Palestine. In the first chapter we have the threatened approach of the Syrians and the flight of the brothers and their families for safety—Nathan to Alexandria, and Eliakim to the almost inaccessible Tel Modin, where he had property, and where lived Mattathias and his family. The victorious Syrians, after conquering Jerusalem,

attempt to force their heathenish rites upon the Jews. Mattathias resists, and the noble Judas, aided by his brothers, head the rebellion. For a few years the rebellion is successful, and Judas becomes the High Priest; but eventually he falls before the army of Lysias. We are grateful to Miss Yonge for weaving such an interesting story about the career of the Maccabeans. There is romance supplied by the different members of the families who intermarry, and we gain much information about the history, manners, and customs of the Jews, in the period anterior to the Christian era. As a prize or gift book, we heartily recommend 'The Patriots of Palestine.' There are five full-page illustrations by W. S. Stacey.

A Roman Household. By G. Norway. (The National Society's Depository.) This is a story-book well fitted for older children. The household was that of Paulus, a Roman of high position in the service of Nero—that Emperor whose chief delight was in shedding blood. Many of the early Christians were sent from Palestine to Rome and sold as slaves. A Jewish Christian family from Antioch, or rather the mother and daughters, became slaves in the household of Paulus. By their gentle forbearance, ready obedience and patient endurance of their unhappy lot, these slaves—who had been of importance in their own country—exercised a grand influence for good in the Roman household. Lucius, the only son of Paulus, loved the gentle Marta, and on her martyrdom became a Christian and a preacher. His sister Emilia, wilful and proud, proved her love for Claudius, the patrician Christian, when he was placed under the ban of Nero. It is impossible in a short review to say more of this interesting and well-written book. At times the writing is graphic, and there are some splendid scenes, notably that of the entry into Rome; and again that of the bear fight in the Coliseum. We unhesitatingly recommend this book as being one of the best gift books of the season.

The Autobiography of a Bull Dog. By Mrs. N. Peel. (The National Society's Depository.) Mrs. Peel has made 'Bully' the medium for teaching young folks the ethics of stability of character. Bully was one of the favourite dogs in the family of Colonel Beecher. In his own quiet charming doggie style he gives us an account of the life of his companions, interwoven with the history of the Beecher family. Lady Jane Beecher's gentle character, with its noble influence for good upon her scapegrace boy Henry, is effectively drawn, and the contrast with Lady Ann very marked. Pincher, the mongrel terrier, is most entertaining, and shows that Nature's gentlemen depend not on birth or breeding alone. We close the book, only sorry that there is not more of it, and congratulate Mrs. Peel on the charm of her story, for which we have nothing but praise.

My Lady's Slippers. By Mary H. Debenham. (The National Society's Depository.) This is one other of Miss Debenham's clever and interesting tales, the period being the time of the Jacobite rebellion. Joscelyn Felton, of Upwood Hall, has to flee the country, and his wife gets a shoemaker to hide her diamonds in the heels of her slippers. She joins her husband abroad, and after their death their son Hilary is left in the charge of Walter Gaythorne, a faithful attendant. When Hilary is fourteen they return to England to the village of Upwood, and in the meantime his father's cousin has taken possession of Upwood Hall. By an odd chance Hilary has kept his mother's slippers, and he gives them to his cousin Cynthia, who afterwards becomes his wife. Before that event happened, the family diamonds were discovered, together with a crumpled yellow paper, and Hilary came into possession of Upwood Hall. Hilary's bright and cheerful nature and Walter's faithful devotion to his trust stand out prominently, and the little schoolmaster is a good character. The tale is uncommon and fascinating. The book is beautifully illustrated and attractively bound.



'FRENCH AND ENGLISH.' (T. Nelson & Sons.) *See p. 340.*

The Stone Door. By Fred C. Badrick. (The National Society's Depository.) Captain Shawcross was the God-fearing owner and skipper of the good brig *Talyfan*, trading between Liverpool and the Continent. Returning from Rotterdam with a valuable cargo, partially

consisting of laces for a Chester tradesman, the crew mutinies and the poor captain is cast adrift. He falls into the clutches of Algerian corsairs, but shortly gains his freedom as a reward for performing a gallant action. He returns to his home in Penmaenrhos, only to find that his wife has died brokenhearted, and his only son gone to sea with the object of earning enough money to clear the good name of his father. The two moving spirits of the mutineers and the villains of the piece are Richard Waters, the clever ne'er-do-well son of a scrivener, and James Martindale, an unscrupulous sailor. The denouement takes place after many years, when these two rascals, returning for their illgotten booty—hidden in a cave to which the Stone Door gave access on the land side—are discovered by Capt. Shawcross and his son. The incidents are not so luridly sensational as in some boys' books, and consequently convey a greater air of probability. The 'Stone Door' is a capital story book for boys.

'OFF TO KLONDIKE.' (James Nisbet & Co.) *See p.* 344.

A Guilty Silence. By A. E. Deane. (National Society's Depository.) An excellent story for young people, showing that ill-gotten gains do not bring happiness. Mr. Stevens has disowned his daughter because she married against his wish. He lodged with a family called Gray, and the eldest daughter, Margaret, who is a governess, intercedes on his daughter's behalf, and induces him to make a will in her favour, annulling the will leaving all his possessions to the Gray family. After Mr. Stevens' death the lawyer announced that the Gray family were his heirs, Mrs. Gray having the will leaving all to the daughter, which she kept back. The Gray family do not prosper with the riches so dishonestly gained, and one of the sons is ruined by gambling and stealing. Mrs. Gray at last goes to Mrs. Springfield, the daughter of Mr. Stevens, and informs her of the later will. Margaret, who does not know of the later will, becomes the governess to Mrs. Springfield's children, and the Grays become poor again. 'A Guilty Silence' is an interesting book and well illustrated.

Gwen. By Penelope Leslie. (National Society's Depository.) Gwendolyn and her brother Daniel had been sent into the country to their grandmother's because they had the measles. They are very mischievous children, and always getting into scrapes. After their parents go to India for a year, an aunt stays with them, and Daniel is sent to a boarding school. Their grandmother gives them some kindly advice, and so they are ultimately brought to a sense of their wrong-doing.

The Uncharted Island. By Skelton Kuppord. (T. Nelson & Sons.) Beginning with an escapade of two school-boys which leads to unexpected consequences, this story soon develops into the record of a remarkable mystery connected with hidden treasure. The place of hiding is unknown, but a strange map is understood to be the clue, and is supposed to represent an island somewhere on the earth's surface. The reader must not, however, expect any sort of imitation of Stevenson's 'Treasure Island.' The story is full of surprises, and the interest is of an absorbing nature. Sometimes one is inclined to suspect a humorous trick of the writer, the trick of raising anticipations to end in the discovery that the whole tradition is an empty fancy. But the mystery has a real foundation, and is unravelled with wonderful ingenuity. The extravagant yarns of the one-handed seaman, Old Hookey, are marked with genuine humour and inventiveness.

French and English: a Story of the Struggle in the West. By E. Everett-Green. (T. Nelson & Sons.) In its main features this story keeps close to the recorded facts of that great struggle between the French and English for the colonial empire of the West, which found its climax and its close in the daring capture of Quebec by General Wolfe in 1759. The book reads like a veracious history, and presents vivid, almost painfully vivid, pictures of the conflicts between the Indians and the Settlers, and of the attacks on Ticonderoga, Fort William Henry, and Louisbourg. With the historical narrative is skilfully interwoven a very attractive story of adventure and romance. The characters of the leaders are carefully delineated, and the manner in which Wolfe's career is set forth is particularly impressive. A book like this, combining instruction with exciting deeds of heroism, has a value beyond that transient interest which characterises many works produced as gift-books.

The White North: with Nordenskiöld, De Long, and Nansen. By M. Douglas. (T. Nelson & Sons.) The story of the 'heroic sailor souls' who have laid down their

lives in the attempt to scale the icy barriers of the 'White North' must always be fascinating to British boys. In this book we have the thrilling record of Arctic exploration brought down to the moment when the *Fram* cast anchor in Pipervik Harbour and her heroic commander passed in triumphal procession through the streets of Christiania. The magnificent courage and endurance of Nansen and his companions, their hardships and adventures, are described by the author in a way that is sure to enchain the attention of young readers.

Through Peril, Toil, and Pain. By Lucy Taylor. (T. Nelson & Sons.) This is a historical novel of great power and skill. The incidents of the tale take place in the red days of Queen Mary, when the blood of the martyrs was the seed of the church. Kathleen Tregelles, the daughter of a London merchant who was ready to change his faith to suit the times, had been brought up as a strict Catholic. A young gospeller, Christopher Howard, puts a copy of Tyndale's Bible into her hands and bids her 'read, mark, and learn.' The result is that she casts off the faith of her fathers and becomes an ardent Protestant, ready to testify with her life to the truth of the Scriptures. Her uncompromising steadfastness brings her to a prison cell and very nearly to the stake. The cry of 'Long life to Queen Elizabeth!' however, opens her prison door at the moment when the flames await her. While following Kathleen's story we have a vivid picture of London when the fires of Smithfield were lighted. All the great personages of Reformation times are introduced, and fiction becomes the handmaid of history. At a time when the principles established at the Reformation are being forgotten or discounted in certain quarters, staunch adherents of Protestantism will be glad to put this book into the hands of their growing sons and daughters.

A Fighter in Green: a Tale of Algeria. By Herbert Hayens. (T. Nelson & Sons.) Such a fruitful theme as the French conquest of Algeria was bound to attract a writer of war-romances sooner or later. Mr. Hayens is fortunate in being the first in the field. The subject has inspired him, and he has given us a work which will rank with the best of his stirring productions. The bare story of the combat of Frank and an Arab is a romance in itself. Mr. Hayens has made it positively fascinating. He has turned his attention more especially to the campaigns in Kabylia, where the Berber inhabitants were filled with the most ardent patriotism and fiercely contested every inch of soil. The hero, Edward Harrington, is an Englishman. In the opening scene he interferes on behalf of a poor Arab boy, and finds himself involved in a prospective duel with a German captain. Sent away at a moment's notice on special service, the duel is postponed. Harrington carries despatches to various fortresses across the country, and on the way meets with adventure after adventure. Joining the army which is attacking the mountain fastnesses of the Djurdjura Range, Harrington wins the Cross of the Legion of Honour by saving a countryman from the Kabyles, at the risk of his own life. Nor is this the only deed of derring-do he performs. The leader of the Kabyles, a tall man in a green burnouse, is the soul of the resistance. He is ubiquitous, and wherever he appears the mountaineers seem animated to miracles of heroism. In his scouting excursions Harrington finds a little girl, who becomes his special care. This little girl turn outs to be the daughter of the fighter in green—Caddour. Caddour desires to have the child handed over to him and arranges a private meeting with Harrington to discuss the matter. The meeting is discovered by a party of Zouaves, Caddour fells Harrington and leaps away crying 'Traitor!' The French soldiers assume Harrington to be in communication with the enemy, and a cloud of suspicion hangs about him for a time. Later on he undertakes to lead a forlorn hope against an almost impregnable mountain stronghold, and all doubts as to his loyalty are set at rest. He engages the

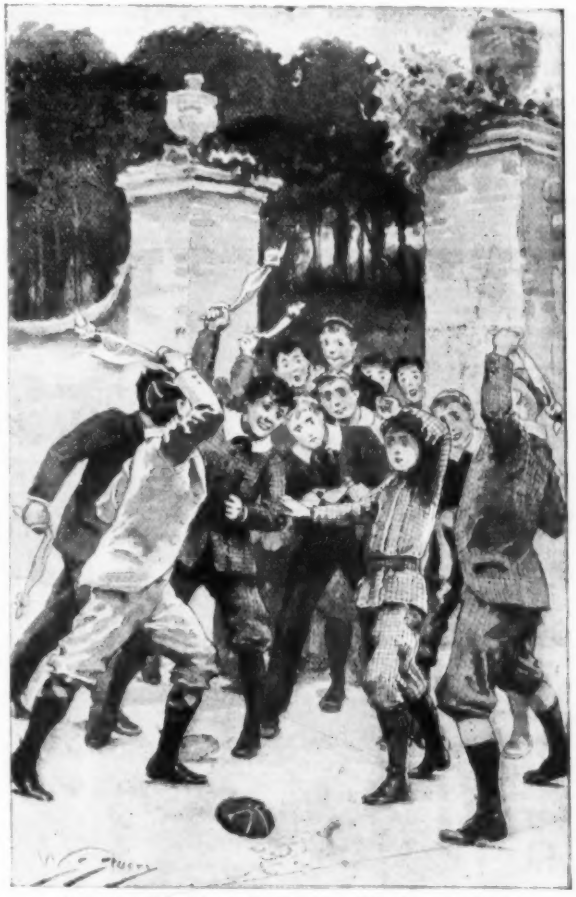
WESTWARD HO!" (Ward, Lock & Co.) *See p.* 346.

'fighter in green' hand to hand; he is wounded and taken prisoner by the enemy. Caddour cares for him, and the Kabyle leader and the Englishman become great friends. During the progress of their conversation they discover that they are brothers. How Harrington escapes from the Kabyles, how Caddour, or Sir Albert Harrington as he must now be called, is rescued from prison in Algiers, and how the brothers return to England, home and fortune, must not be told. No boy who has once begun this admirable story will leave it until he comes regretfully to the last word. Mr. Talbot-Kelly's spirited illustrations are a distinct feature of the book.

Tom Tufton's Toll. By E. Everett-Green. (T. Nelson & Sons.) This is a sequel to Miss Everett-Green's story 'Tom Tufton's Travels.' It describes in spirited fashion the daring deeds of a band of highwaymen, who are represented as acting under the guidance of men of rank and position who sought by illegal and violent acts to redress some of the unfairness in the distribution of wealth. The time of the story is the reign of Queen Anne, and the scene is laid chiefly in and near Epping Forest. In the earlier chapters we are inclined to think there is a good deal of that false glamour which invests the highwayman with noble ideals of honour and justice, and makes evil doings wear an appearance of righteousness. Before the end of the book the hero of the story and his abettors are brought to see the error of their ways, and their intensely exciting adventures come to a peaceful close.

Esther's Charge. By E. Everett Green. (T. Nelson & Sons.) Esther's charge was the custody of two young cousins, Pickle and Puck, whose names sufficiently indicate their characteristics. Esther was a girl of excessive timidity and nervousness. The companionship of the boys gave her self-confidence, while her gentleness had its influence on the rougher natures of her cousins. Despite her gentleness, Esther was able to prove herself a heroine by rescuing her uncle from a terrible death. The story is excellently told and cannot fail to prove interesting to young girls.

King Alfred's Viking. A Story of the First English Fleet. By Charles W. Whistler. (T. Nelson & Sons.) There are two circumstances that should make this story especially attractive—the first is the interest aroused in our great English King, Alfred the Truthteller, by the approach of the millenary celebration, and the second the present interest in all things pertaining to our navy. The story is one also which will thoroughly repay the trouble of reading it. The Viking is Ranald Vemundsson, who tells how he obtained the Sword Helmbiter, how he came to our southern shores at the time when Alfred was busy in the making of his fleet, and how he accepted a position of responsibility in connection with that work. There is some warrant in history for this main idea, and the narrative includes a series of important events in the actual life of Alfred. These are told in a style peculiarly suited to the subject, the diction being simple, slightly archaic, with a touch of poetry and of music. The characters of such men as Odda of Devon, Denewulf the herdsman, and Neot, the kinsman of Alfred, are vividly drawn. The Pixies' Dance, Black Twelfth Night, Alfred's life in Athelney, and the battle scenes are very graphically presented.



'GREEN GARRY.' (Oliphant, Anderson & Ferrier.) *See p.* 346.

The Triple Alliance: Its Trials and Triumphs. By Harold Avery. (T. Nelson & Sons.) This story opens with the advent of a new boy at a boarding-school at Chatford. Of course he has to run the gauntlet and be generally reckoned up by the community. He shows himself of real grit, and wins the firm friendship of two others, and the three form a triple alliance which stands the test of years at 'The Birches' and at Ronleigh College, a larger public school. The book is full of striking incidents, which prove what scope the commonwealth of a public school affords for the play of wicked machinations and of heroic qualities. One cannot but notice how much larger is the share of the playground and the free time of the boys in the development of the story than is the work of the class-room. The descriptions of the Wraxby Match and of the Reading-room Riot, the incidents connected with the Secret Society, and the Cipher Letter, and those recorded in 'a Chapter of Accidents,' are full of the absorbing excitement relished by most school-boy readers. The triumph of right over wrong makes a good ending to the story.

In the Grip of the Spaniard. By Herbert Hayens. (T. Nelson & Sons). This tale records the adventures, chiefly military, of a young Spanish officer, Captain Alvarado, who tells the story, and his English friend Harry Lawton, also a captain in the Army of Patriots, who under

command of Bolivar, the famous Liberator, succeeded in freeing Venezuela from the Spanish yoke. The author, whom we have met with before on similar fields, is thoroughly at home with his theme. His narrative, with its short, crisp paragraphs of clear, direct statement, moves with extreme rapidity, and his style is marked by a verve and a vigour which admirably befits his story. Stirring episodes—'hair-breadth escapes, and moving accidents by flood and field'—follow each other in quick succession. The passage of the Andes; the escape from prison; the incident of 'the assassin's knife'; and the final victory of Carabobo, are capitally told. The love element is introduced in the last chapters, and so a thrilling story is brought to a pleasant ending. It is cleverly illustrated by Wal Paget.

Off to Klondike. By Gordon Stables. (James Nisbet & Co.) The name of Gordon Stables on the back of the book is usually a sufficient testimony to its sterling worth, but we confess to something like disappointment on reading this tale. Possibly the excellence of previous works may have led us to expect too much. We are a long time in getting to the tale, which when told is not convincing. In spite of some passages indicating the difficulties, the general impression given is that the journey to Klondyke is a kind of picnic. The hero appears as an escaped convict, who, befriended by some children, manages to prove his innocence. He leaves England, and after lecturing on our Prison System in New York and the States, drifts into cowboy-land, where he meets with many adventures, and thence to San Francisco and Klondike. Here he is so lucky that he returns to England for his sweetheart, and takes her back, together with the children who assisted him, and whose parents (strange to say) offer no objection. Of course they make their fortunes and return to spend them in the old country. The description of the routes to Klondyke are interesting, and many scenes are written with the charm which has placed the author in the first rank of writers for the young, but the story as a whole does not ring true.

The Treasure Cave of the Blue Mountains. By Oliphant Smeaton. (Oliphant, Anderson & Ferrier.) This should prove a popular book for boys. It has all the characteristics that lads love. Whilst the plot does not strike one as being very original in itself, ye in its development there is plenty of novelty. The author evinces a thorough knowledge of Australian life. The tale really consists in the adventures which befall three retired miners, John Cameron, William Arbuthnot, Arthur Roberts, and a girl, Lelia Cardiff, in their journey from Sydney to the Blue Mountains in search of a countless hidden treasure. The secret document which is the chart and key to the gold is furnished by one John Cardiff, who, being sick, as he thinks, unto death, hands it over to John Cameron. There is quite enough of fighting and hair-breadth escapes to satisfy the most bloodthirsty reader. All ends happily in the marriage of John Cameron and Lelia Cardiff upon their return after finding the treasure.

Pirate Gold. By J. R. Hutchinson. (C. Arthur Pearson, Limited.) The character of this book is well indicated by its title. We confess there is too much bloodshed for our liking; but you cannot have *angels* men where the passions are inflamed with a lust for gold, especially if it be in the form of hid treasure. Here are all the types of character to satisfy the most exacting love of adventure, and the boy who reads this book will simply revel in it. The story is told with a realism and power of dramatic force, and with a knowledge of matters, manners, and language of things nautical which leave nothing to be desired by those who love sea-adventures of the good old sort. The book is well printed on excellent paper, and there are several illustrations.

'THE GIRLS OF ST. WODE'S.' (W. & R. Chambers.) *See p.* 346.

John of Strathbourne. (C. Arthur Pearson, Ltd.) This is a romance of the sort loved by boys. It deals with the life of one Jean, an English boy, son of an English knight who was murdered by Jacques Tapin, a French peasant, for the sake of his money. A ring, which the knight carried round his neck, and a letter were secured and secreted by the peasant's wife, who gave them to Jean on her death-bed. By means of the letter he ultimately established his identity. The ring played a most romantic part in several crises in his life, and secured for him the hand in marriage of one of the highest ladies in France.

One of the most absorbing periods in Jean's life was that in which he unwittingly sold himself to the captain of the Thousand Brigands of the Mountains. The story is admirably written throughout, and the

interest never flags from the first page to the final scene, which is dramatic in the extreme. The printing and paper are excellent, and add much to the pleasure of reading the story.

The Boy's Own Annual; The Girl's Own Annual. (Religious Tract Society.) We fear the reading world is scarcely aware of the debt of gratitude it owes to the Religious Tract Society for their efforts during the past twenty years to supply the youth of the English speaking race with so much really helpful literature. We well remember in the early eighties visiting the Society's depot, and listening to an account of the warm welcome given to the issues of these magazines. The courageous attempt in those days to sweep away all that was unwholesome has since resulted in the greatest possible success. The flourishing condition of the magazines to-day is ample evidence that they are well fitted to their purpose, and satisfy a need in a way unequalled by similar contemporaries. Each volume contains over 800 pages of reading and pictorial matter. First on the list of 'The Boy's Own' contributors is that giant among boys' writers, G. A. Henty, from whose pen the most stirring and popular stories ever appear. G. Manville Fenn, Harold Avery, Jules Verne, and several other equally well-known names are among the chief writers of serial stories. G. Hawley, Ascott R. Hope, and many others contribute a series of short stories. In an entertaining and most instructive series of short papers many subjects are cleverly dealt with under the heading of Amusements, Pastimes, Games, etc. Short Natural History papers on boys' pets also come in for efficient and interesting treatment. The staff of 'The Girl's Own' includes an equally distinguished band of contributors, and among the many features of the magazine are the best of serial stories, short stories, household, medical, and a variety of other specially useful papers. Nor must we forget to mention new Music and Musical Papers by such experts as Sir George C. Martin, Myles B. Foster, etc., etc. The volumes are thickly interspersed with beautifully printed engravings in addition to a number of Fine Art plates, executed in the best possible style, from famous paintings, original drawings, etc. Brimful of the best stories, replete with original, sound, and practical information, well printed, and sent out to the world in bindings charming in simplicity and good taste, these volumes are of amazing value, and cannot fail to prove ideal presents for young people.

'THE BRIGHT KERNEL OF LIFE.' (Jarrold & Sons.) *See p.* 347.

Bible Text Book. By John Jackson, F.E.I.S. (Sampson Low & Marston.) The purpose of this book is to afford material for devout meditation for every day of the year by means of correlated texts of Scripture, embodying a 'Prayer,' 'Promise,' and 'Precept.' The following selection of texts for Jan. 12th gives a very good idea of the plan of the book :—

Prayer : 'Lead us not into temptation.'
Promise : 'I will keep thee from the hour of temptation.'
Precept : 'Watch and pray that ye enter not into temptation.'

The book is printed in two colours throughout, and is tastefully got up. It may be carried about in the pocket—a desideratum for this class of book.

In Goodly Company. By Frances E. Cooke. (Swan Sonnenschein & Co.) This book is in its way a mild protest against the too stimulating diet of *stories* only. It consists of ten selected biographies of men and women who have made a good name for themselves in different spheres of life. Thus we have Frances E. Willard, Robert Dick, the Scotch Baker Boy and Naturalist, Dean Stanley, Florence Nightingale, James Nasmyth and others. Boys and girls are equally well catered for, though every chapter may be read by either sex with profit. The book is written in an easy and sympathetic style, and the type and paper make it a pleasure to read.

Crecy and Poictiers. (Ward, Lock & Co.) This is a magnificent prize book of nearly 400 pages, and is a marvel of value at the price. It is excellently got up as to printing, binding, and illustrations. The book deals with one of the most stirring periods of English History, and in such a way that it is sure to be read from cover to

cover. It is the story of the famous Black Prince and his page, who is the narrator of the story. The attention of the Prince was attracted to the boy by the success of the latter at the quintain. A certain air of mystery surrounds the whole of his career, and the secret of his identity is maintained to the last. The book is full of interest and instruction, and is sure to be popular.

Westward Ho. (Ward, Lock & Co.) To those who are on the look-out for a healthy and stimulating book for boys, this edition of Kingsley's naval romance will come as a welcome boon. We envy the boy whose Christmas holiday is to be associated with the first reading of this thrilling story of the good old days when

'Hearts of oak were our ships.'

Although 500 pages are put into a two-shilling volume everything is well done; the illustrations are superb; it is well printed, and forms a most attractive gift book.

The Throne of David and **The Prince of the House of David.** By Rev. J. H. Ingraham. (Ward, Lock & Co.) These well-known books have been written from a devout and eminently laudable standpoint. The author has attempted by the embellishments of literary art and a lively imagination to weave the sacred narrative of Holy Scripture into an attractive and readable form for the young. They are intended not to supplant but to supplement the Scriptures. The former book depicts, with full Eastern colouring, the stirring events connected with Saul, David, Jonathan, and Samuel; and the latter consists of a number of letters written to her father by a young Jewess who is represented as an eye-witness of the wonderful events of our Lord's earthly life. She writes in an attractive style, and fills up the narrative with much ability and appreciation. The books are eminently readable for young or old, and their price places them within the reach of all.

Barriers Burned Away. By Rev. E. P. Roe. (Ward Lock & Co.) This book, by a well-known author, is in all respects an attractive one. The author describes it as the 'first child of my imagination.' The story was suggested by the harrowing incidents of the Great Chicago Fire. It deals with the life of one Dennis Fleet, who was left in early boyhood to fight the battle of life alone. As usual the first rungs of the ladder were hardest to find, but Christian principle, and a character marked by much courage, patience, and self-abnegation, triumphed over all obstacles, until, with 'every barrier burned away,' the summit of the hero's ambition was reached. The book will repay perusal by young or old. It is attractively got up in striking colours and gilt edges, and forms an excellent gift book.

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2. School Stories for Boys.

Doctor Cubitt's Cubs, by A. B. Romney (Blackie & Son), is a cheerful story, and ends well. 'You duffer; don't you know that all boys who come to school here are called "Dr. Cubitt's Cubs," and are always Backwards, Delicates, or Unmanageables? Now, which are you? *I'm* both a Backward and an Unmanageable.' Such is the address of the first boy to the second, and the third is the delicate one. Kitty, the doctor's little daughter, is the heroine of the book, who by her irresistible, frank good-nature softens and warms even the Unmanageable, and braces the Delicate into renouncing tears and tale-bearing. But is not the deliberate leaving of a small boy alone on a rock to be surrounded at high water too brutal an act even for a neglected and resentful 'Unmanageable' of active habits?

Stolen or Strayed, by Harold Avery (Nelson & Sons), is a school story, and is not very happily named, since a stamp (which is the subject of the story) can hardly be said to stray. Jack, a new day boy, falls under the evil influence of a boarder, the mean boy, who wants to make a fortune out of a stamp, the value of which is unguessed by the owner. He is extricated in the end chiefly by his little sister. The mean boy is shamed before all, and—the stamp proves a worthless forgery. It is on the whole an uncomfortable story, though the writer describes grammar school life with a good deal of vivacity.

Chums at Last: a Tale of School Life. By A. Forsyth Grant. (Nelson & Sons.) In this story, the not-very-reasonable dislike of one boy for another is fed and fostered by successive occurrences, and then brought to an end through a particularly brave action of the one who has been much misunderstood. There is great diversity of character amongst the boys, and the narrative abounds in humorous episodes, and some full of pathos, the latter especially concerning the weakling 'Hoodie,' whose death at school is very touchingly told. There are, of course, cricket matches, and games, and many exciting incidents; and the book may be recommended as a thoroughly interesting school story.

Green Garry. By Marianne Kirlew. (Oliphant, Anderson & Ferrier.) This is a moderately well written tale for schoolboys. Its great drawback is that it is not true to nature. Garfield Glynne is a type of lad who is only existent in the imagination. The aim of the authoress deserves nothing but commendation, but a tale is all the better for not being too obtrusively goody-goody. Then stories of school life are so abundant that it is difficult to introduce much that is novel. The pictures are good, and the get-up all that is desired.

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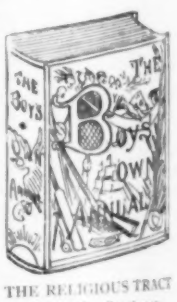
3. School, and other Stories for Girls.

The Mystery of Kittie-Boy. By Jennie Chappell. (Blackie & Son.) Girl readers will perhaps like this book better than boys, and elder girls rather than younger. The tale is not very stirring, but the incidents are pleasing, and the contrasts between the gentle Kittie-Boy and the rough sullen Sam Dent, and between Mrs. Wilkins and kind, lovable Mrs. Dent, are very well drawn. There are two illustrations.

The Girls of St. Wode's. By L. T. Meade. (W. & R. Chambers.) Mrs. Meade has given us in this book a picture of life in a modern girl's college. St. Wode's is a kind of Girton. The characters of the various students are well pourtrayed. We have the blue-stocking Belle Acheson, who is consumed with books and ideals. The chief personage brought before our notice is Leslie Gilroy, who influences the college for good, and has much to endure by having to share the room of one 'Inky' Annie, whose great ambition is to gain mathematical honours. In working for this she often suffers from a mania for solving problems. There is a fair amount of adventure dovetailed into the routine of university life. The illustrations are commendable.

Belle. By the Author of 'Lassie.' (W. & R. Chambers.) Here is a pleasantly-written love-story, which begins with the simple fancy of a child, and proceeds through many complications to a satisfactory close. The writer plays with considerable skill on the chords of sadness and humour, of romance and stern reality; and throughout contrives to hold the interest of the reader. The book is suitable for girls just over the age for school.



THE RELIGIOUS TRACT SOCIETY. *See p.* 349.

Ruth Farmer. By Agnes Marchbank. (Jarrold & Sons.)

This is a well-written tale for girls. At the opening of the story the two sisters, Amy Paterson and Alice Sutherland, are introduced to our notice. The former is living unhappily with her husband, and her sister happily. The authoress weaves around Amy Paterson a story of the consequences of incompatibility of temper. Amy leaves her husband and lives apart from him for three years. He, thinking her dead, is arranging to marry again, when events transpire which bring about their reconciliation. The ending is much more hopeful.

The Girls of St. Bede's. By Geraldine Mockler. Illustrated by A. J. B. Salmon. (Jarrold & Sons.) This is an interesting and pretty story of school-girl life. Margaret Ashdean who, is sixteen years old, is sent to a boarding school for two years by her rich grandfather, who had disapproved of his daughter's marriage, and had not communicated with her for seventeen years. At the school she meets her cousin Julia, who lives with her grandfather. Julia knows her cousin by name and dislikes her, while Margaret does not know that Julia is her cousin. Through Margaret's independence and the animosity shown by Julia, she is at first unpopular, and Julia does all she can to get her disliked by all the girls, as she is afraid that her grandfather will prefer her cousin to her. Julia puts some of her jewellery in a sandal-wood box of Margaret's, but she is found out, and after Margaret saves her from drowning she is very repentant. Girls will like this story so much that they will not be able to put it aside until completed, and its healthy tone makes it an excellent prize book. It is neatly bound, and the two illustrations are good.

The Bright Kernel of Life. By Isabel Stuart-Robson. (Jarrold & Sons). This is a thoroughly wholesome book, and one which should command a large circle of readers. The authoress knows how to cater for those for whom she writes. To such stories as this one we look to prove a powerful antidote to the cheap, aimless, and impossible novels of the day. We confidently commend it to all who are seeking useful and attractive prize books for girls.

Phoebe Deacon. By Hude Myddleton. (Jarrold & Sons.) This is a charming story for girls, full of interesting events and wholesome teaching. The plot is of a higher order than usual. The heroine is a beautifully-drawn character, who, among other good deeds, accomplishes the reformation of a young man who was well nigh ruined. This book is well worthy of a place in libraries in girls' schools.

The Rose of Dawn. By Lilian R. Knight. (Jarrold & Sons.) This is a commendable attempt to cultivate among girls a love for something above the usual common-place love story. The authoress shows an acquaintance with the history of the Britons during the Roman occupation which does her credit. The tale is told with much skill and fascination. Its sound moral teaching, which is not too obtrusive, should win for it a place in girls' libraries. We prophesy for it success.

The Last of the Haddons. By Mrs. E. Newman. (Jarrold & Sons). This is pre-eminently a *safe* book for girls, in which crime and excitement have no place. The story is a simple one, destitute of any striking characteristic, yet told in such a natural and pleasing manner that, once commenced, few girls would wish to put it aside till it has been finished. It is a recital of self-denial and of self-effacement for the sake of others' happiness which will affect its readers for good, although such sacrifices as are described are very rare in every-day life. That the book is interesting, is evidenced by the fact that this is a second edition.

THE RELIGIOUS TRACT SOCIETY. *See p.* 345.

Gildas Haven. By M. S. Haycraft. (Jarrold & Sons.) This is what girls in their later teens call 'a lovely book.' It would make an excellent prize for evening school girls. They would quite enjoy the *dénoûment* of the tale after following eagerly the ups and downs of life, both before and after marriage, of the young curate and Gildas Haven. It is a case of Husband and Church *versus* Wife and Chapel; and ecclesiastical prejudice runs so high between them, notwithstanding their marriage had been solemnised at what was thought to be the curate's death-bed, that they agree to separate. But a preliminary absence teaches Gildas that she cannot live apart from her husband, and the way love conquers all their difficulties and leads them to a happy quiet life, is just what the reader has been hoping for. The illustrations are pleasing.

Reine's Kingdom. By L. E. Tiddeman. (National Society's Depository.) Reine was the eldest child of the Lestrange family, and having lost her father eventually became the chief support of the family. The story shews how this happy climax was reached; for Reine, being a clever girl, was at first inclined to rebel against her lot and to fancy that her genius was wasted. Unfortunately this feeling was encouraged by Miss Farrant, a rich but selfish lady, who, whilst assuming to help Reine to cultivate her intellect, only fed her selfish ambition. However Reine's better nature triumphed, and she ruled her kingdom with 'the sceptre of love.' Reine's gentle mother; the out spoken but kindly aunt; Stephen, the goodnatured cousin, are characters which help to make a really capital story. Girls will read it with avidity, and be the better for it too.

When Hyacinths Bloom. By Ida Jackson. (Oliphant, Anderson & Ferrier.) This is a very pleasing story of family life, told with fascination. It should prove attractive and interesting to girls. The opening scene is one of sorrow—misfortune has overtaken a respectable and well-to-do family on the death of the father and the failure of the business. Widow and daughters, reduced in circumstances, let lodgings at the seaside. The daily life of these form the bulk of the tale. The mother dies of a broken heart. The daughters, after much endurance, find their reward for their piety in good husbands.

The Great House of Castleton, and **Patricia.** By Winifred Graham. (C. Arthur Pearson & Co., Ltd.) This brace of stories will suit those who are on the look-out for reading of the unconventional and *anti-goody* style. The first story takes its name from an old Elizabethan House which was rented by a Mr. and Mrs. Marsh for their two town-bred daughters, who are joined by their two cousins. Whether it is the effect of the bracing air of the country, or the reaction from life in London, or the absence of the parents, who do not appear on the scene until nearly the close of the story, we leave our readers to determine; but they simply run riot over the old house, the ghosts, secret chambers, and out-of-the-way places, and explore boxes, pictures, and valuables in an alarming way. Their parents make their appearance on the scene in the midst of a gigantic ball they have organised, with refreshments telegraphed for from London. 'Patricia' is a girl of a most unconventional type. She is supposed to be under the tuition of a German governess, but she persists in being her own tutress, and very well she succeeds. Her escapades and exploits would not do discredit to a well-ordered boy of the mischievous sort, but Patricia is the light of her father's eye, and shows, as in the time of Fraulein's illness and dismissal, some undercurrent of good feeling and sympathy.

Melbourne House. By the Author of 'The Wide, Wide World.' (Ward, Lock & Co.) This handsome reprint of the first volume of the 'Daisy Series' by E. Wetherell forms a splendid prize book for girls. The gifted authoress has created for young readers a character which will be sure to captivate their imagination, and leave a deep impression for good upon their heart and life. The

book is decidedly religious in tone and purpose, and will do much to render the conception of the Christian life for young people a possible and real one. There are over 400 pages of excellent reading matter.

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CHRISTMAS & NEW YEAR'S CARDS.

Messrs. Raphael Tuck & Sons, the celebrated house in the Art publishing world, are again early in the front rank with their collection of **Christmas** and **New Year's Cards, Calendars, Books, Booklets, Toy-Books**, and a varied selection of **Art Novelties.** To-day Messrs. Tuck claim that their new collection in all its divisions and sub-divisions is once more in advance of its predecessors, and that the immense variety, wide range, and absolute novelty, together with rare beauty and high finish, are more than ever the distinguishing characteristics of their productions. For a number of years past we have examined this firm's Illustrated Catalogue, with a selection of specialities, and we have not the least hesitation in saying that the claim is honestly and amply justified by this season's magnificent output. Over 1,400 sets of entirely new designs, grave, gay, lively, and severe, have been specially reproduced this year in the best possible styles of Colour, Tone, and Black and White. It is impossible in our limited space to furnish a detailed list of their innumerable specialities, and were we able to do so, we fear our readers would hardly thank us for a mere list of titles, which in themselves would convey little meaning. It will suffice if we say that there are Cards of every description—masterpieces of art in design and colour—and in endless variety of artistic shape; 'Sweet Lavender' perfumed Boxed Cards, Platino Panels, and Calendars. The last mentioned are splendid examples of the best original work. The highest talent has been employed, with the result that Messrs. Tuck have a collection of 170 entirely new designs, which, for variety, ingenuity, and artistic merit, are said to be unequalled. The Toy-Books are as usual excellent specimens of lithographic art, and would prove most acceptable presents to hand to the little ones. This extensive series includes a new ABC Book on untearable linen, Painting Books, and Books with Moveable Pictures. Messrs. Tuck inform us that their efforts have this year been appreciated by the trade in the most acceptable of all forms, viz., by a substantial increase in large stock orders. We are not surprised to learn this. The artistic excellence of the firm's work has ever been appreciated both at home and abroad; and in annually sending forth such a wonderful assortment of specialities, they have established for themselves a world-wide reputation for the highest technical workmanship in the careful production of all that is beautiful and charming in colour and design. We earnestly advise our readers, before making purchases during the coming season, to seek the treasures of Messrs. Raphael Tuck and Sons, and they will thank us for the recommendation.

CHRISTMAS AND NEW YEAR'S CARDS. (Raphael Tuck & Sons.)

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FOR THE LITTLE ONES.

Mother's Little Lady: a Story for Little Girls. By Edith King Hall. (Blackie & Son.) A tale of a little girl who played in a London square, and at Ascot; chiefly designed to inculcate good manners.

A Small Small Child. By E. Livingston Prescott. (James Bowden.) This thin quarto, produced in the neat style of modern art, suggests a pleasant story for the little ones; but it appears to be more suitable for adult readers. It might be classed as an idyll of military prison life; for it tells in graceful fashion how the influence of 'a small small child,' who appears but once to the reader, effects something like the redemption of a man of brutal nature. The sombre atmosphere of the story and its deep pathos remove it from the class of children's tales; but its simple straightforward style, its earnest tone, and its wholesome moral, are merits which should commend it to the thoughtful reader. Some good wood-cut illustrations from drawings by A. D. McCormick make the volume more attractive.

Two Little Pilgrims. By M. M. (Burns & Oates.) Two little orphans from Spain are in charge of their grandmother, who is unsympathetic but honourable, at Kiev in Russia. They read about Crusaders, and are fired by the idea of joining a band of pilgrims on their way to Palestine. In the absence of their grandmother, the neglect of their nurse makes their start easy, and at the end of the first day's march the deacon Ivan says 'It is the Lord's doing,' and makes no attempt to send them back. After many hardships and setting an example of holy devotion to all, the little brother and sister reach the end of their long pilgrimage, and at last die singing a hymn side by side in the early Christmas morning after receiving their first communion at Bethlehem. The worldly grandmother receives their little wooden shoes, worn through and stained with blood. The careless nurse reforms, and devotes herself to foundlings. The book is intended for the edification of little Roman Catholics, but we doubt if any children will care for these unearthly little beings who are constantly rapt in devotion, or clasping their hands in ecstasy. The writer has evidently been an eye-witness of many of the

scenes described, and the book may conceivably be of interest to adults.

Soldiers of the Queen (Dean & Son) is the title given to a new toy, which is sure to be warmly welcomed by any boy or girl. There are two boxes, viz. :—No. 1. Cavalry Box is made out of two Forage Caps, one an Officer's, and the other a Trooper's (one fitting inside the other) with chin straps, and contains a Trumpeter and a full troop of the 15th Hussars, *i.e.* a Captain and 22 Non-commissioned Officers and Troopers mounted, all carrying 'steel' swords. No. 2. Infantry Box is also made out of two Forage Caps, one a Sergeant's, and the other a Private's, with chin straps, and contains a Major (mounted) and a Company of Scots Guards, *i.e.* one Captain, two Lieutenants, five Sergeants, and 56 Privates. All are made to stand up, and are from designs by Richard Simkin. The Troop and Company can be drilled and paraded in various ways. The boxes are sold at 1s. each, and are undoubtedly among the cheapest and most amusing toys obtainable.

The Story of Moses, retold by the Rev. T. Johnson, and illustrated by Ayoub and Gunston, and the **Story of Joseph**, by the same Author and Artists, are among the newest issues of Messrs. Dean's Diploma Picture Book Series. The story in each case is set in bold type, and the brilliant colouring of the pages is bound to please our little ones, for whom the books are specially designed.

Illustrated Fairy Books (Macmillan & Co.), with Hugh Thomson as artist, call for careful criticism.

Jack the Giant Killer (Macmillan & Co.) is before us. The old story is simply and vigorously told, and the somewhat unpleasant hasty-pudding episode not too much emphasised. There are sixteen full-page coloured illustrations. Some of these appear slightly confused at first, but they are full of interesting detail, and children will be thrilled by the three ladies tied up by their hair, and the team of horses dragging the giant out of the moat. Giants do not admit of graceful treatment, and these are not unnecessarily repulsive. The text is bordered by small uncoloured illustrations, some of which are excellent, *e.g.*, that of the workman sawing half through the planks of the bridge across which Jack is subsequently to lead the giant to his downfall. The picture of the wedding at the end is tinged with a vulgarity from which the grotesques of the different giants are free. The princesses and other ladies concerned are mostly really pretty.

The Magic Nuts. By Mrs. Molesworth. Illustrated by Rosie M. M. Pitman. (Macmillan & Co.) If stories may be classified, as narrative poetry has been classified, into the 'naive' and the 'artificial,' certainly this comes under the last head. A little girl, imbued with fairy lore, travels to Germany, where she makes friends with another little girl. Each has mysteriously become possessed of three nuts. On opening these by pairs they are transported in succession to 'gnome-land,' 'tree-top-land,' and to a 'blue silk room,' where 'a spinning-wheel fairy' relates a story of 'The unselfish mermaid.' The tale is in good taste, but has none of the verisimilitude of the Adventures of the immortal Alice, nor of the experiences of Dr. Macdonald's Princess and Curdie : it is in sooth a trifle dull. It contains some good bits of description, and the illustrations are graceful.

Jo: A Stupid Boy, and other Stories. (National Society's Depository.) A collection of eight short and simple stories, making a very suitable gift-book for young children. The title story 'Jo' teaches the lesson that stupid and dull children may yet be strong and noble in character, and possess a very keen idea of what is right. 'Owen's opportunity,' is, perhaps, the best of the eight, and gives a good sketch of a self-reliant and high-spirited boy; but all are written with the object of encouraging nobility of character.

The Golden Picture Book. (T. Nelson & Sons.) This is a miscellany, well-bound, and in good, large print, and full of charming pictures, many of them daintily coloured. The first story of three little children from India who find their grandfather can tell them delightful stories, forms a prelude to the rest. Some of the stories are the common property of the world, *e.g.*, those of King Midas and Hop o' my Thumb ; others are modern.

The Children's Treasury of Pictures and Stories, 1899 (T. Nelson & Sons), is another miscellany containing some good pictures. Its pages will be turned over with pleasure in many a home.

Round the Farm: a Picture Book of Pets. By Edith Carrington. (T. Nelson & Sons.) This is a charming book, wonderful for the money, and exactly what is needed as a picture book for young children, especially for those in towns, whose knowledge of country life is so sadly deficient. Cows, donkeys, horses, hens, ducks, dogs, cats and kittens, dogs and puppies, rabbits, pigs—nothing more remote than the deer of Richmond Park. Many of Landseer's pictures are effectively used. The reading matter is in large print, and generally suitable for young children. Many of the smaller pictures are in outline, and older children will find it delightful and easy to colour them in watercolour.

The Animal Alphabet. Illustrated by E. B. S. Montefiore. (T. Nelson & Sons.) From the same publishers is another equally satisfactory book. The rhymes are bright and pointed ; for instance :—

'G is for Giraffe, as he stands at his ease,
He can nibble his meal from the tops of the trees.'
'P is for Parrot, who knows his own name ;
Just call him "Poor Poll," and he says it again.'
'S stands for Stork, his stilts are so high
He can walk in the water and keep himself dry.'

The pictures are every one of them vigorous and characteristic, and excellent in colour ; the soft tones in which the large letters are printed add to the general artistic effect of each page.

The Rose and the Ring. By W. M. Thackeray. (Smith, Elder & Co.) Though the tastes of the present day have wandered somewhat from Thackeray and his contemporaries, to the writers of adventures in the gold diggings, and the jungle, on the veldt, and the high seas, it is hardly likely that the work before us will lose its popularity as a children's nonsense book. As a whimsical absurdity, as one of the last of the fairy tales, with its fun enhanced by the still funnier illustrations, it must be accorded a foremost place in any list of children's prize-books. The binding and general 'get up' is excellent.

Prince Uno. (C. Arthur Pearson & Co., Limited.) This story was first told to a sick boy who, in the crisis of a serious illness, required something to make him forget his pains and danger. Stimulated by love and an intense desire to effect his purpose, the author pressed his best gifts into this effort of imagination, and thus laid the foundation of these excellent tales. The adventures of Uncle Frank are as delightful as they are stimulating. His transformations from pigmy, as he enters the enchanted ground of the fairies, to giant so big that he cannot stand upright in a circus, but must needs lift the upper part bodily, like a huge umbrella, to find room for his head and shoulders, will strike the imagination of young readers, while the ease with which he catches a lion between thumb and finger, or holds an elephant in the palm of his hand, will not escape wondering notice. His exploits among the fairies of the water, the forest, and the air are charmingly told, and his rescue of the son of the Prince Uno from the wood sprites forms a fitting climax to one of the best series of fairy tales we have read. The book is profusely illustrated, printed on superior paper and gilt edged, and forms a capital gift book.

Notices of 'Books for the Little Ones' will be continued in the Christmas Number.

THE L.L.A. OF ST. ANDREWS.

B.—THE DEPARTMENT OF PHILOSOPHY.

LOGIC AND METAPHYSICS.

BY THOS. CARTWRIGHT, B.A., B.SC. (LOND.)

Author of 'Mental Science and Logic for Teachers.'

BOOKS TO BE STUDIED.

(1) Jevons' 'Elementary Lessons in Logic,' with Cartwright's 'Mental Science and Logic for Teachers.'

(2) Mill's 'Logic,' Books I., II. with chaps. 1–8, and 21 of Book III., and Douglas's 'John Stuart Mill.'

(3) Ryland's 'Psychology,' 7th edition.

(4) Fraser's 'Selections from Berkeley.'

(5) *For reference only*, Minto's 'Logic, Inductive and Deductive.'

Jevons' 'Lessons in Logic,' Lessons XXIV.—XXXIII.

Lesson XXIV.—With this chapter begins our study of that branch of the science of inference known as **induction**, by which general laws, rules, principles, or truths are ascertained from the collection and examination of particular facts. We shall have occasion to go more deeply into this branch of our subject when we enter upon the study of the books in Mill's 'Logic' which are set down for study in the official syllabus, for it was Mill who popularised this section of logic. As Jevons says, the chapters in his 'Logic' are preliminary to Mill's more exhaustive treatise, and what we propose to do is, to go over this introduction to induction thoroughly, so that the student, having grasped clearly the simple outlines given by Jevons, may be in a position to profitably take in hand the detailed study of induction as set forth in the pages of Mill's book.

In the first place, the student should get a clear idea of the divisions of logic as set out in chap. xix. M. S. and L. under the three heads of **immediate inference**, **syllogism**, and **induction**. In immediate inference we get a conclusion from one premise only, as when from *all metals are elements*, we proceed to the conclusion that *some of the elements are metals*. In syllogism, or mediate inference, as it is more aptly termed, we compare two things with a common third thing, and then proceed to a conclusion, which expresses likeness or difference between the two things thus compared with the mediate thing. Here we must have two premises in which the two comparisons with the mediate thing are expressed, thus :—

All the metals are elements.
Iron is a metal.
∴ *Iron is an element.*

Here element agrees with iron because they both agree with one and the same thing, viz. metal.

It is to be noted that the conclusion is less general than the premises, *e.g. all the metals* is wider in denotation than *iron*, and this is usually the case. Indeed, the conclusion cannot be wider in its application than the premises, because, as was said when syllogism was first brought under study, the conclusion only asserts explicitly what was implicit in the premises.

In induction the premises are usually very numerous, for it would be an act of folly to infer that what has been observed to be the case once or twice, must always be the case. To say that *all dogs are vicious* because one or two dogs have been observed to be so, would be an instance of this fallacy of generalisation from insufficient data. This, then, is one peculiarity of inductive inference, viz., that the premises are many, so that we may classify inferences on this basis of the number of premises necessary to the establishment of a valid conclusion. Thus—(1) immediate inference : *one* premise necessary ; (2) mediate inference : *two* premises necessary ; (3) inductive inference : *many* premises necessary. But by far the most important consideration concerning inference deals with the generality of the conclusion as compared with the degree of generality obtaining in the premises. As observed above, in (1) and (2), the conclusion cannot be wider in its denotation than its premises, whereas, in inductive inference, it is the very essence of the process that the conclusion should have a wider generality than the premises from which it is induced. Thus, to quote the instance given in our prefatory remarks on induction, the premises are, *this magnet, that magnet, the other magnet*, attract iron, from which we conclude that **all** magnets attract iron. We do not seek to examine all magnets. Every additional magnet that agrees with previously examined ones in attracting iron increases our belief in the universality of this property in magnets, and at last we say unhesitatingly that *all magnets*—including those existing in past and present time, as well as those that will be found to exist in times to come—*attract iron*. This most important point must be well understood before any progress whatsoever can be made in the study of objective or inductive inference, as it is variously named. Furthermore, it is to be desired that early attention be paid to the various names under which this passing from particulars to generals is known. We have already spoken of induction as objective inference. This name is applied to the process because the generalisation depends, not upon the mind, but upon a law of external nature in virtue of which the conclusion obtains its certitude.

It will be convenient to set out in tabular form the various names applied to deduction and induction, and then to give a few words in support of the appropriateness of the terms in question.

DEDUCTION.	INDUCTION.
(1) The method of Instruction.	(1) The method of Discovery.
(2) Subjective Inference.	(2) Objective or Material Inference.
(3) Logical Synthesis.	(3) Logical Analysis.
(4) *A priori* reasoning.	(4) *A posteriori* reasoning.

(1.) Jevons' remarks on the learning of a language very aptly mark the fitness of these two names as indicating the fundamental difference between the downward progress from general rules to instances of their application, and the upward passage from particular facts to the general laws, rules, principles, or truths, of which they are examples.

(2.) With this we have already dealt.

(3.) Synthesis is a placing together, and here we would draw the particular attention of the student to a difficulty. It is not always easy to see that in applying a general rule we are combining parts into a whole. In fact the student will probably opine that the synthesis is more apparent in the opposite process of adding instance to instance until the general rule appears overwhelmingly true from this piling up of evidence in support thereof. This difficulty is referred to in section 191 of M. S. and L., where it is remarked that 'we are looking at the processes from the point of view of *intension*, which is invariably the case in logical analysis and synthesis, the instances, with all their peculiarities of detail, being the "logical whole," whilst the rules, principles, or general propositions, with their wide extension, but strict exclusion of all peculiarities of detail, form the logical parts.' Let us remember then that it is upon the intension, and not upon the extension, that we must fix our minds, and then we shall see that in proceeding from *this magnet attracts iron*, we separate (or analyse) this particular quality or property from all the other qualities or properties of the magnet that solicit our attention, and that herein is to be found the reason for speaking of the process as an analytic one. The distinction is all the more an important one for us teachers, because inductive teaching—which is, alas, but too rare—is usually spoken of as analytic teaching, whilst the more common procedure, by way of deduction, is commonly described as synthetic teaching.

(4.) The terms *a posteriori* and *a priori* are so common that the student has in all probability encountered them hundreds of times in the course of her reading. Literally *a posteriori* means from the latter, and *a priori* signifies from the former. The student will best remember the application of these two terms in logic by thinking always of the general rule or principle which in deduction is prior to, and constitutes the first link in, a deductive chain, whereas it is posterior to, and forms the last link in, an inductive chain of mental operations. Thus, when the generalization is prior the process is deduction, when it is posterior we have inductive reasoning.

Lesson XXV.—With respect to the **traductions** as to *Sneezing* and *lithium*, it should be remarked that Mill would reject these as not being inductive at all, because the conclusions contain no new truth as compared with the premises, whereas in such an induction as is expressed in *All the magnets attract iron*, there is an assertion respecting some unexamined magnets, which is a new truth not expressed in any of the premises. This will be more fully treated on later. **Perfect induction** is equally faulty ; indeed, the only induction recognised by Mill as **perfect** is the so-called **imperfect induction**, the perfection being due to the fact that we are able to make an assertion concerning unexamined cases, feeling sure from the large number of cases that have been examined and found in agreement with the generalization that the unexamined cases must agree with these. Hence the definition that *induction is inference from the known to the unknown*.

The question as to the ground or reason for the assumption contained in the conclusion of what Jevons calls the **imperfect**

inductive syllogism, is of great importance. Mill postulates the Uniformity of Nature, in opposition to which is to be placed such facts as the retrograde motion of the satellites of Uranus, and similar cases of deviation from observed uniformities. This also will be discussed at fuller length when we deal with Mill.

Lesson XXVI. Geometrical and Mathematical Induction must be clearly grasped by the student who, if ignorant of Mathematics, should certainly get sufficiently advanced in that branch of study to be able to understand the fifth proposition of the 1st Book of Euclid and the little example in Algebra given by Jevons in illustration of these two inductive forms, which also come under what Mill terms induction improperly so called, because, although a general proposition is established, it is not established by inference, but it follows from the fact that 'the proposition proved does not apply to a triangle unless it agrees with our specimen in all the qualities essential to the proof. So that in examining the one triangle we have practically examined every triangle to which the general proposition is applicable. It should be remembered with respect to mathematical truths, that, although they depend upon observation of a few cases, *they acquire certainty from the perception we have of the exact similarity of one case to another.*

In reasoning from **example**, as when a teacher shows a piece of common salt and establishes certain qualities as belonging to it, what we are really sure of is that these qualities belong to the specimen under exhibition. When we assume that all specimens of common salt will have exactly the same qualities, we must remember that this is only true in so far as the specimen is a perfect one, and therefore exactly typical of the class for which it is, as it were, called upon to speak. This is very similar to the very important case of **argument from analogy**, the strict meaning of which, is **identity of relations**, which, however, has been modified so far as to stand for **any resemblance between things which enables us to believe of one what we know of the other.** It would be impossible to give a better example of this seductive, but often unreliable, form of argument than that which holds between Earth and Mars. The conclusion is that Mars is inhabited, and the question is, how far are we warranted in believing this conclusion to be true. According to Mill the value of an analogical argument depends upon three things :—

(1) The amount of ascertained resemblance,
(2) The amount of ascertained dissimilarity,
(3) The amount of unascertained properties ;

and the conditions of validity are—

(1) That the resemblance is very great,
(2) The dissimilarity is very small,
(3) A fairly exhaustive knowledge of the properties of the two bodies between the analogy is to be drawn.

It is highly probable, if not absolutely certain, that there is very much indeed of what we are ignorant with respect to Mars, so that it would be a bold thing to assert that Mars and Earth resemble each other in all important particulars. Note in this connection the words with which Jevons concludes this very interesting and no less important chapter, **'The very narrow basis of experience is compensated by the high degree of similarity.** Although Chapter XX. Book III. of Mills' 'Logic' is not set down for study, it would be very wise for the student to go through this section, which deals with analogy in a masterly manner.

Lesson XXVII.—It should not be difficult to distinguish between the passive observer and the active experimenter, and to realise how much more likely the latter is to discover and interpret nature than the former. It is hard to believe that men should have neglected this means of obtaining knowledge to such an extent as to make Bacon's new instrument such a remarkable innovation. It is true that 'man can himself do nothing else than move natural bodies to or from each other ; nature working within does the rest' ; but it is to be noted that this movement of natural bodies (experiment) causes nature to work within much more frequently and in many other ways than would have been the case had passive observation been the instrument relied upon, instead of active observation, as experiment may be aptly called. Experiment (1) **saves time**, for 'we might have to wait centuries to meet accidentally facts which we can readily produce at any moment in a laboratory. (2) **It creates conditions that could never be met with naturally.** Also note that we could never learn by mere observation what would be the nature of substances under changed conditions. Experiment makes this possible. Logic cannot make an observer.' It can, however, give us this caution—*to discriminate accurately between what we really do observe and what we only infer from the facts observed.* The importance of this caution is not easily overrated, since our senses cannot deceive us, and it is only too common for us to deceive ourselves by false inference, for fallacy lurks in inference, as we have all experienced to our cost. We shall return to this point in our Psychology, meantime the student should carefully note all said by Jevons in this connection.

Lesson XXVIII.—The methods of Induction will be dealt with when we study Chap. VIII., Book III., of Mill's 'Logic,' upon which this Lesson is founded.

Lesson XXIX.—The point enlarged upon here may be expressed in the words that science is first of all qualitative, and then, as it becomes more perfect, it becomes more and more quantitative. The truth of this can be affirmed by every student of science. We first of all ask ourselves, 'Is such an effect produced?' and immediately upon getting an affirmative reply, we at once proceed to ask how much of the cause is required to produce a certain amount of the effect, and suchlike quantitative questions. The method of Concomitant Variations will come under our notice in Mill's chapter on the Methods, so that the student may defer anything more than a casual study of this point until the study of Mill is entered upon, and the same may be said as to the **intermixture of effects.**

Lesson XXX.—Induction by itself would not suffice as an instrument wherewith to unravel the secrets of nature. We might by induction establish the fact of universal gravitation, but, in order to explain the movement of the moon round the earth and of the earth round the sun, it is necessary to apply this induction and to show that these movements of secondaries round their primaries are instances of the application of this law, *i.e.* we must proceed by way of induction and deduction in combination. The mere collection of facts is not enough, the discovery of the general law underlying these facts is not enough. Genius is required of a deductive kind which will be employed in bringing unlikely facts under the general law ; hence the **Deductive or Complete Method** referred to by Jevons. The student must read this chapter diligently and understand clearly the illustrations given by the writer in support of his statements. In addition, she should try and find illustrations from her own experience or reading. This will not at first be easy, but a little practice will make it clear that 'though observation and induction must ever be the ground of all certain knowledge of nature, their unaided employment could not have led to the results of modern science.'

Lesson XXXI.—The subjects dealt with here will again come up for consideration in Book III. of Mill, meantime the student should learn well the following :—

I. That **explanation** harmonises (*a*) fact with fact (volcano and earthquake), (*b*) fact with law (cracking of heated glass), and (*c*) law with law, of which there are three cases, viz., (1) **homogeneous intermixture of effects**, where two similar phenomena merge in a result similar in nature but more pronounced as to effect (path of cannon ball) ; (2) **intermediate effects of a cause** (thunder) ; (3) **case of a more general law** (electricity).

The terms **tendency** and **hypothesis** should present no difficulty. The former is exemplified whenever the effect of a cause is disguised by the effect of another cause. The cause does not produce its effect, but it tends to do so, and would do so were it not for the presence of the counteracting cause.

Concerning the latter it must be observed that an unverifiable hypothesis is absolutely valueless, however ingenious it may be, and that the greater the number of facts explained by a hypothesis the greater the probability that it is a real law of nature, and not a mere creature of the imagination. Newton's **hypotheses non fingo** (I do not construct hypotheses) applies to useless guesses incapable of verification.

Note.—**Theory** = (1) *hypothesis*, (2) *science* (not art), (3) *fact* ; and **fact** = (1) *thing known*, (2) *particular instance of a law*, (3) *truth*.

Lesson XXXII.—To understand this chapter the student must be quite certain that she has truly fathomed the meaning of abstraction and conception. In forming a conception, or general notion, we abstract the attributes common to all the individuals denoted by the general name, from the peculiarities of these individuals, and so we become conscious of a multitude of resembling things, every one of which corresponds to the general notion that we have formed, but not one of which fails to present peculiarities not necessary to the members of the class, and which are not included in our conception of the class. When this is clearly seen it will need no proof to show that abstraction, conception, generalization, and classification are all involved in each other. To organise knowledge is the aim of classification, whereby the capability of the mind is greatly increased. The requisites to good classification are to be well marked : (1) It must be **appropriate to the purpose in hand** ; (2) **enables the greatest number of general assertions to be made.** This will only be the case when the classification is perfect, because the individuals included in the various classes resemble each other fundamentally, such fundamental or deep-seated resemblances being certain to carry with them hosts of other minor resemblances. Definition is of course most intimately connected with

classification, and the statement that the definition should *contain as few characters as possible which should carry as many propria as possible* is only a reiteration of what has just been said concerning deep-seated resemblances. The remarks as to a **natural system** of classification are worthy of special attention, and especially that we are enabled thereby to infer of all members of a class what we know of any one member.

When the quality abstracted is peculiar to the class we can only associate members of the class with this quality; hence, when we abstract this quality from the other qualities, we are still tied down, as it were, to this class. If, on the other hand, the quality is not peculiar to the class but is possessed by other classes, then when we separate this quality from the other qualities connoted by the class name, we lessen the connotation and increase the denotation, *i.e.* we generalize; for this single quality is associated with more objects than was the group of qualities from which we have detached it, hence under ordinary circumstances to abstract is to generalize.

Lesson XXXIII.—This is a very important chapter. The first thing is to realize to what extent thought is possible without language, and so arrive at the second of these three purposes served by language. A little introspection will convince the student that language is indeed a mechanical aid to thought. That it is a means of communication and an instrument of record and reference, needs only to be stated to be accepted as true. The lover of mnemonics may perhaps like to be reminded that the word CAR (communication, aid, record) will serve as a mechanical reminder of this threefold function. The third of these three purpose is undoubtedly of most importance, and therefore it should be carefully remarked that an instrument of record should be (*a*) *precise*, and (*b*) *complete*. A little reflection as to the way in which our own language has grown will make these two points abundantly clear, whilst at the same time it will show how far our language—and it is true of all—falls short of these necessary requirements of a philosophical language. The 'certain and knowable meaning' is too often replaced by an uncertain and unknown meaning, as indeed may be gathered from the statement previously made, when terms were under consideration, that a univocal term is practically unknown.

The difference between a *descriptive terminology* and a *nomenclature* should present little or no difficulty. There must be names for the classes and sub-classes that are formed, and these constitute the nomenclature. It is equally evident that there must be terms appropriate for describing the various qualities, and relations appertaining to these classes and sub-classes, which is what is meant by a descriptive terminology.

The special meaning of the term **natural kind** is to be noticed, although the condition of differing from all other classes, not by one or a few definite properties, but by an unknown multitude of them is very vague.

Questions from Previous L.L.A. Examinations.

(1) Explain the nature of Inductive Inference, and the principles on which it depends. What is meant by saying, that 'all inductions in physical science are only probable?' (1888.)

(2) What is the nature of argument from Analogy? On what conditions does the soundness of an analogical argument depend? (1888.) (1890.)

(3) Distinguish Observation and Experiment. Give an account of the fallacies incident to the process of observation. (1890.)

(4) Define and distinguish—cause, condition, law of nature, uniformity of nature, universal causation. (1891.)

(5) What is the relation of induction to deduction? (1892.)

(6) Define carefully Analogical Argument, and estimate its value. (1892.)

(7) What is meant by:—(1) natural law; (2) cause; (3) the ground of induction? (1893.)

(8) 'Deduction proves particulars from universals, Induction proves universals from particulars.' Examine this view, and state precisely what is meant by Induction. (1894.)

(9) What are the functions of hypothesis in scientific investigation? State the conditions of a legitimate hypothesis. (1889.)

(10) Explain the following phrases:—(*a*) imperfect induction; (*b*) empirical law; (*c*) placability of causes.

Answers to the questions set are corrected by the author of this course at a charge of 10s. for the whole series of questions. The name and address of the student should be distinctly written on the first page of his MS., only one side of the paper should be written upon, each page should be numbered, and a stamped addressed envelope should accompany each instalment of work sent. With each batch of papers must be enclosed the current coupon of the PRACTICAL TEACHER, for as this offer is made in the interest of subscribers to the PRACTICAL TEACHER alone, on no account, and for no amount, can papers be received without the coupon.

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LONDON MATRICULATION.

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LATIN.

Latin Course for December.

1. Revise the first 20 chapters of 'In Catilinam,' and read 10 chapters of 'Pro Marcello.'

2. Grammar:—The regular conjugations and the formation of the tenses; deponent verbs; semi-deponent and quasi-passive verbs; verbs in *-io* of the third conjugation; formation of *inceptive*, *desiderative*, *frequentative*, and *diminutive* verbs. In the syntax read the genitive and ablative cases.

3. 'Anglice Reddenda,' 45–52.

Sentences from Bradley's 'Arnold,' or Bayfield's or Allen's 'Exercise Book.'

Latin Grammar Notes.

The four regular conjugations of verbs should be carefully gone through, and the resemblances which they bear to each other should be noted. The resemblances are well brought out in the comparative table of endings in the grammar. Note that deponent verbs are verbs that are passive in form and active in meaning, and are so called because they lay down (*depono*) the passive meaning. They are the only verbs that have a perfect active participle; some deponent verbs have a perfect participle with a passive signification. Note the verbs in *-io* of the third conjugation like *capio*, *facio*, etc. These verbs drop the *i* before *i*, *e* final, or short *er*. Semi-deponent verbs are passive in form in the perfect tenses. Quasi-passive verbs are active in form and passive in meaning, *e.g.*, *veneo*, *fio*, *vapulo*.

The translation of the present subjunctive by 'may' is only correct (1) in wishes, as 'may he do this,' *hoc faciat*; (2) in a final clause, as *hoc facio ut valeat*, 'in order that may he be well.' Otherwise 'may' is translated by *licet* when equivalent to 'it is permitted,' or by *potest fieri ut* when equivalent to 'it can be that;' *e.g.*, *ei hoc facere licet*, 'he may do this'; *potest fieri ut valeat*, 'he may be well.'

The pluperfect subjunctive is translated by 'should have' when it occurs in a principal sentence, otherwise the pluperfect indicative in English generally translates it. You must remember that the subjunctive is rare in English, but very common in Latin.

The two English translations of the Latin perfect should be noted. The context decides which is to be used. It should be remembered that the perfect with 'have' is regarded as a primary tense, the perfect without 'have' as a secondary tense. This distinction, as we have pointed out in the sentences, has an important bearing on the tenses of the subjunctive in dependent clauses. In the syntax, note the remains of the locative case in names of towns and small islands, *domus* and *rus*.

Note the mode of expression when the word *urbs* or *oppidum* is used, as *in urbe Roma*, 'in the City of Rome.'

Note that motion 'from' is normally expressed by the abl. with a preposition, except in the names of towns or small islands. *By*, after a passive verb if used (1) with the agent, is translated by *a* or *ab* with the ablative, (2) with the instrument is not translated, and the ablative alone is employed. With regard to method of expressing price, the genitive is used for indefinite, the ablative for definite (and sometimes indefinite), price, as *hoc pluris vendidit*, *hoc tribus sestertiis vendidit*.

Learn the distinction between the ablative and genitive of quality, noting that the noun in the ablative or genitive must have an adjective; *e.g.*, 'a man of bravery' is not *vir fortitudine*, but *vir fortis*.

Note the ablative of origin. Note the ablative of manner and ablative of accompaniment. Note that with the latter the preposition *cum* is used, unless there is an important adjective used with the noun.

Note the ablative of the amount of difference—the ablative of comparison; *e.g.*, '*rex melior est illo*,' '*sol multis partibus est maior*,' 'The king is better than that man,' 'the sun is many parts larger.' Note the ablative of respect (in poetry we find the accusative of respect): '*Gallos virtute superant*,' 'they surpass the Gauls in valour.'

The ablative of attendant circumstances, or ablative absolute, is very important. The examples of it given in the grammar are well worth studying. The following are the limits to its use:—(1) The subject of it must be independent of the rest of the sentence; *e.g.* *eo absente Caesarem laudavit*, 'he praised Caesar in his (C.'s

absence,' is not to be imitated, where *eo* refers to *Caesarem*. The sentence should run, *Caesarem absentem laudavit*. (2) The ablative absolute should be a short clause. Poetical and Greek usages of the genitive and ablative are important. Note the following:—(1) Gen. of respect, *integer vitae*, 'upright in life'; (2) gen. of separation, *desine querelarum*, 'cease from complaints'; (3) gen. of cause, *notus in fratres paterni animi*, 'known on account of his fatherly feeling towards his brothers'; (4) ablative of place without a preposition. Note the different methods of translating the preposition 'with' into Latin. The constructions of *dignus, indignus, contentus*, and *fretus* are important. Students should avoid using *dignus* and *indignus* with genitive, as that construction is not found in Cicero. Distinguish the subjective and objective genitive: *e.g.*, *amor patris*, 'the love felt by a father' (the father is the subject of the love), subjective genitive; *amor patris*, 'the love felt for a father' (the father is the object of the love), objective genitive. The predicative genitive is the genitive used as a predicate with the verb *est*, as *stulti est hoc facere*, 'it is the mark (sign, characteristic) of a fool to do this.' Note the construction of *interest, refert, circumdo, induo, fruor, fungor, vescor, utor, opus est, interdico*. The classes of verbs that are followed by the genitive or ablative are important. Among the principal genitives expressing offences, accompanying verbs and adjectives of accusing, note the following:—*Repetundarum* (extortion), *veneni* (poisoning), *maiestatis* (high treason, the full phrase is *laesae maiestatis*), *ambitus* (bribery), *furti* (theft), *caedis* (murder), *peculatus* (embezzlement), *homicidii* (manslaughter). Note 'to accuse of violence, assassination' *de vi, inter sicarios accusare*.

Note that the ablative expresses (1) point of time, (2) time within which an event happens. Also note the different ways of translating 'three days after.'

Typical Sentences.

(10.) All of you will be afraid that the general will take by storm the city of Athens.

Omnes timebitis ne urbem Athenas imperator expugnet.

Notes.—(*a*) 'All of you' must not be translated by *omnes vestrum*, as 'of you' is not a true partitive genitive; but 'all' and 'you' are co-extensive: hence say 'you all.' The 'you' can be omitted, as it is contained in the termination of the verb. (*b*) After verbs of fearing, a 'that clause' is expressed by *ne* and the subjunctive; a 'that not' clause by *ut* (or *ne non*) and the subjunctive. An infinitive in English is expressed by an infinitive in Latin. (*c*) The present subjunctive *expugnet* is used because *timebitis* is in a primary tense, and the action of *expugnet* is future to that of *timebitis*. (*d*) Note *Athenas* is in apposition to *urbem*, instead of being in the genitive, as you would expect from the English. The Latins in such cases do not use the genitive of definition.

(11.) Instead of offering battle to the enemy, the general preferred to march with his army to Capua and wait for the reserves.

Cum hostibus pugnandi copiam facere posset (deberet) dux cum exercitu suo Capuam contendere et subsidia expectare maluit. [Or, *Ubi non dux hostibus pugnandi copiam fecit ut cum exercitu . . . malle.*]

Notes.—(*a*) *Instead of* followed by a verbal noun in English must not be translated by *pro* and the gerundive in Latin. There are two or three ways of expressing it: (i) by *cum . . . posset*, when neglected opportunity is implied; (ii) by *cum . . . deberet*, when neglected duty is implied; (iii) by *adeo non* ('to such a degree not') . . . *ut* ('that') and subjunctive. (*b*) Note the phrase for 'offer battle to' lit. 'give an opportunity of fighting'—*pugnandi* is genitive depending on *copiam*. (*c*) *Expectare* 'wait for,' and is equivalent to our word 'expect,' when expect = wait for.

(12.) Do not tell your friend to put trust in such a man as this, if you wish to consult his interests.

Ne amico tuo dixeris (or *noli . . . dicere*) *ut huic tali homini fidem habeat, si ei consulere vis.*

Notes.—(*a*) A prohibition in the second person must not be expressed by *non* and the *imperative*: *ne* and the *imperative* would be poetical; *noli* (or *nolite*) with the infinitive, or *ne* with the *perfect subjunctive*, are the ways adopted in prose; *ne* with the *present subjunctive* is used when *no particular* person is addressed (hence called the '*ideal*' subjunctive), as in 'thou shalt not kill.' (*b*) *Ut* with the *subjunctive* is used to express English *infinitive* after verbs denoting 'ask,' 'command,' etc. (*c*) *Dixeris* is here = a primary tense; hence the present subjunctive *fidem habeat*. (*d*) *Fidem habere* is followed by dative. (*e*) Such a man as this = 'this such a man'; *talis* = 'such' before a noun; *tam* = 'such' before an adjective or adverb. (*f*) The *indicative* is used after '*si*' when there is an indicative or imperative used in the *apodosis* (principal clause). (*g*) *Consulere* with dative = 'to consult the interests of'; hence *ei*.

(13.) I cannot help telling you that it is of great importance to the state and to us that this citizen of Rome should help the wretched Scipio as much as possible.

Non possum quin tibi dicam nostra et civitatis magni interesse ut hic civis Romanus Scipionem hominem miserum quam maxime adiuvet.

Notes.—(*a*) 'I cannot help,' followed by a verbal noun, is expressed in Latin by *non possum quin*, followed by the subjunctive. (*b*) *Dico* = *I tell that*, is followed by the *infinitive*. (*c*) 'It is of importance to' is expressed by *interest*. The person or thing to whom a thing is of importance is expressed by the *genitive*, except when a personal pronoun represents the person, in which case the *abl. fem. sing.* of the corresponding possessive adjective is used (the genitive, however, of the 3rd non-reflexive personal pronoun is used); hence we have *nostra* and *civitatis*, above. Note that the first person precedes the third in Latin. (*d*) The thing that is of interest is expressed either by (1) the *infinitive*, (2) an *ut* clause with subjunctive, (3) by a neuter pronoun, (4) by a '*utrum . . . an*' clause. (*e*) 'A citizen of Rome' is not '*civis Romae*,' which = 'a citizen at Rome,' but '*civis Romanus*.' (*f*) Do not say *Scipionem miserum*: adjectives are not closely attached to proper names: use *homo*, as above. (*g*) *Adiuvo* is followed by *acc.*

Sentences for Practice.

1. He could not help telling your brother and me that we ought to have stormed the city of Capua a week ago.
2. On hearing that the consuls had marched to the city of Syracuse, he made up his mind (*statuo*) to go to Naples as soon as possible to inform his friend of this.
3. All of us ought to have prevented him from pitching his camp near the city of Capua, ten miles from the camp of Cæsar.
4. Who was afraid that he would not arrive at Rome so as to prevent the soldiers from murdering the unarmed (*inermis*) citizens?
5. We have no hesitation in saying that it is your interest, as well as that of all patriotic (*bonus*) citizens, to resist such men as these abandoned wretches.
6. Instead of making it his aim to save the State, he actually formed the design of helping the enemy in every way in his power.
7. Do not let him know why I have determined to place all my hopes of safety in battle.
8. Having fought a successful engagement, Cæsar broke up his camp (*movere castra*) and advanced by forced marches to the city of Paris (*Lutetia*).
9. Instead of praising the deeds of this hero (*vir*), he actually was bold enough to blame him.
10. It is a matter of great importance to you and to us whether we shall see to-morrow's sun in safety (*tutus*) or not.

Test Paper.

1. How are *inceptive, desiderative, frequentative*, and *diminutive* verbs formed in Latin? Form verbs of this kind from the following words: *rogo, clamo, video, cano, edo, canto, aboleo, iuvenis*.
2. What classes of verbs in Latin can govern a double accusative? What becomes of the two accusatives if these verbs are used passively? Illustrate your answer by examples.
3. What classes of verbs govern the dative?
4. Write out short sentences illustrating the construction of *venio, faveo, parco, peto, rogo, facio, consulo, resisto, curro, iubeo, impero*, when used (*a*) actively, (*b*) passively.
5. What do you mean by *semi-deponent* and *quasi-passive* verbs? What participles does a deponent verb possess?
6. Tabulate the chief uses of the accusative and dative.
7. Explain the terms *ethical dative, double dative, predicative dative, dative of advantage, cognate accusative, accusative of respect, accusative of goal of motion*. Frame short sentences in illustration.
8. Correct or justify—
   (*a*) Tremunt artus.
   (*b*) Omnes Romanorum milites faverunt.
   (*c*) Milites duce invidebantur.
   (*d*) Ad Romam ivit.
9. Decline throughout—*totum pelagus, ingens opus, dies felicior, anceps proelium, quaeque celeris navis*.
10. Give the Latin for (*a*) every third man, (*b*) all the best men, (*c*) two letters (of the alphabet), (*d*) two letters (epistles), (*e*) three camps, (*f*) one camp, (*g*) twice two are four.

ENGLISH.

Grammar: Verbs—Nesfield, pp. 45–85; 336–358.
History: From the death of John to the death of Edward III.

English Notes.

The reigns of Henry III., Edward I., and Edward III. are extremely important. The most important events are: (*a*) the Barons' War, (*b*) the Conquest of Scotland and Wales, (*c*) the Hundred Years' War. The causes and progress of these should

be known. The battles fought in this period are important, especially the battles of Lincoln, Lewes, Evesham, Dunbar, Stirling, Falkirk, Methven, Bannockburn, Halidon Hill, Sluys, Auberoche, Crecy, Neville's Cross, Poictiers, Navarette. The growth and development of Parliament should be known. Note 1254 as the date when knights of the shire were first summoned; 1265 when burgesses were first summoned. Note the Mad Parliament, the First House of Commons, the Model Parliament, and the Good Parliament. Note the Provisions of Oxford, the Mise of Lewes, the Mise of Amiens, the Dictum of Kenilworth, the Confirmatio Chartarum, the Salic Law, the Statute De Tallagio non Concedendo, the Statutes (*a*) of Westminster, (*b*) Quia Emptores, (*c*) Quo Warranto, (*d*) De Donis, (*e*) of Mortmain, (*f*) of Provisors, (*g*) of Praemunire, (*h*) of Labourers, (*i*) of Treasons. Lives of the following men are important:—Peter des Roches, Hubert de Burgh, Simon de Montfort, Balliol, Wallace, Bruce, Gaveston, Despenser, the Black Prince. Be able to give an account of Annates, Tallages, the Lord Ordainers, the Black Death, Introduction of the Mendicant Orders. The rise and growth of English towns is an important question; also be able to give some account of the Rise of the Free Labourers.

Grammar Notes.

Learn the definition and classification of verbs. Be able to define transitive and intransitive verbs, strong and weak verbs, auxiliary and principal verbs. Note how intransitive verbs are made transitive. Define voice, mood, and tense. Learn a classification of the tenses. Learn the principal uses of the moods. Discuss the origin of 'to' with the infinitive. Trace the history of the participles and verbal nouns, and distinguish their usage in modern English. Be able to comment on such phrases as 'I am a doing of it,' 'I insist on him going away,' 'a well-read man,' 'a walking-stick,' 'writing of this is difficult,' 'a speaking tube,' 'a speaking doll,' 'after having done this.'

Note the History of the *Infinitive* (pp. 349–351).

Note what is meant by verbs of Incomplete Predication. The uses and history of *shall, will, ought, must, can, may, might, have, be, do, dare, should, would*, are very important. Know at least six examples of verbs which have the same form in the present and the past tenses. Learn six examples of verbs that have two past participles. Learn the inflections which verbs admit. Define conjugation. Note that strong verbs are older than weak verbs, and be able to give reasons. Be able to discuss the terms regular and irregular verbs. Learn a classification of strong verbs. Note the two remnants of reduplication in English. Note *yclept, star-y-pointing* (Milton). Learn the results of the decay of verbal inflections. Be able to define impersonal or unipersonal verbs, with an account of their usages. Note sentences like 'Methought I by the brook of Cherith stood.' Note the usage and the history of the auxiliary and anomalous verbs. Be able to give instances of verbs (*a*) formerly *weak*, now *strong*, (*b*) formerly *strong*, now *weak*.

MATHEMATICS.

GEOMETRY COURSE.

Euclid III. to Propositions 1 to 10, and a revision of Book II.

Solutions to last month's riders:—

(1) Since P and Q are the middle points of BA and BC respectively, it follows by Article 1 of the section on parallelograms at the end of Book I. (Hall and Stevens) that PQ is parallel to AC.

Similarly RS is parallel to AC.

$\therefore$ PQ ,, RS.

Similarly PS can be proved to be parallel to QR.

$\therefore$ PQRS is a parallelogram.

(2) Construct a triangle ABC whose sides AB and BC are the same lengths as the two given sides, and of which AC is twice the given median.

Complete the parallelogram ABCD. Join BD.

Then ABD will be triangle required, for if BD and AC intersect in O, being diagonals of a parallelogram they bisect each other.

Therefore AO = OC and BO = OD.

$\therefore$ AO = $\frac{1}{2}$ AC = given median.

(3) is worked in Hall and Stevens, exercise 21 at end of Book II.

Riders for December:—

(1) In any triangle the sums of squares on the two sides is equal to twice the sum of squares on half the base, and on the median bisecting the base.

(2) ABC is a triangle right-angled at A, and AQ is perpendicular to BC. Prove rect. BC.CQ = square on AC.

(3) Given the hypotenuse and the difference of the other two sides, construct a right-angled triangle.

ARITHMETIC COURSE.

Chapters XXX. and XXXI. of Pendlebury, and plenty of the examples should be worked.

Last month's examples:—

(1) ·00000 or to 6 places ·000001.

(2) Here in 4 years £500 has interest £90.

$\therefore$,, ,, £100 ,, £18.

$\therefore$,, 1 ,, £100 ,, £4½.

$\therefore$ rate per cent. is 4½.

(3) $(\cdot4321)^9$ is less than $(\cdot44)^9$ and larger than $(\cdot43)^9$.

$(\cdot44)^2$,, ·2 (being in fact = ·1936).

$\therefore$ $(\cdot44)^4$,, ·04.

$(\cdot44)^5$,, ·0016.

$(\cdot44)^9$,, ·001.

$(\cdot43)^2$ is larger than ·18.

$(\cdot43)^4$,, ·032.

$(\cdot432)^8$,, $(\cdot032)^2$ *i.e.* than ·001.

$\therefore$ $(4321)^8$,, ·001.

And $(\cdot4321)^9$ is less than ·001

$\therefore$ the ninth is the power required.

Examples:—

(1) At what rate per cent. compound interest will £500 amount to £564 in 4 years?

(2) Find the amount compound interest 5 per cent. in 3 years.

ALGEBRA COURSE.

Chapters XXI. and XXII. of Hall and Knight, and plenty of the examples found therein, say, every third example.

Solutions to last month's examples:—

(1) $x^4 - xy^3 = x(x^3 - y^3) = x(x-y)(x^2+xy+y^2)$

$x^2 - y^2 = (x-y)(x+y)$

$x^3 - x^2y - xy^2 + y^3 = x^2(x-y) - y^2(x-y)$

$= (x-y)(x^2-y^2)$

$= (x-y)^2(x+y)$

$\therefore$ L.C.M. $= x(x-y)^2(x^2+xy+y^2)(x+y)$

H.C.F. $= (x-y)$

(2) $x^4 - 64 = (x^2-8)(x^2+8)$

$x^4 + 64 = x^4 + 16x^2 + 64 - 16x^2$

$= (x^2+8)^2 - (4x)^2$

$= (x^2+4x+8)(x^2-4x+8)$

(3) $4x^4 - 12x^3 + 13x^2 - 6x + 1$.

(4) $\dfrac{x^2+xy+y^2}{(x+y)(x^2-xy+y^2)^2}$

Note $x^4 + x^2y^2 + y^4 = x^4 + 2x^2y^2 + y^4 - x^2y^2$

$= (x^2+y^2)^2 - x^2y^2$

$= (x^2-xy+y^2)(x^2+xy+y^2)$

(5) Let x and y be the two numbers.

Then $x + y = 20$ (a)

and $x + 7 = 2(y+6)$ (b)

or $x - 2y = 5$ (c)

Solving (a) and (b) we get $x = 15$

$y = 5$.

Examples:—

(1) Simplify $\dfrac{1}{x^2-y^2} - \dfrac{y-3x}{y+x} - \dfrac{1}{y-x}$.

(2) Find the H.C.F. of

$6x^3 - x^2 - 20x + 12$ and $6x^3 - 13x^2 - 21x + 18$.

(3) Calculate $\dfrac{1}{\sqrt{4}}$ to 4 decimals.

(4) Add together $\dfrac{3x-4}{x-1} - \dfrac{7x+10}{1+x} - \dfrac{11x-5}{1-x}$.

GENERAL SCIENCE.

Chapters VIII. and IX. of Jones and Simmons, and a revision of the previous work. The questions at the ends of the chapters should be worked.

Test Papers in Mathematics and Science.

(1) State Boyle's law. How may it be experimentally verified? How much ordinary air will be required to fill a diving bell at a depth of 20 feet? (Height of mercury barometer = 30". Sp. Gr. of mercury = 13·5.)

(2) Describe an experiment verifying the parallelogram of forces, drawing a figure for the case of forces 3 lbs., 4 lbs., and 5 lbs.

(3) Divide $b^3 + c^3 - 1 + 3bc$ by $b + c - 1$.

(4) Describe a circle passing through 2 given points, and having its centre on a given straight line.

(5) Prove Euclid II. 13 by the figure of I. 47, keeping to Book I.

QUERY COLUMN.

RULES.

1. Each correspondent is restricted to *one* question.
2. Each query must be accompanied by the *coupon* which appears on the back wrapper of the current number of the Journal.
3. CORRESPONDENTS MUST IN ALL CASES STATE THE SOURCE FROM WHICH THEIR QUERY HAS BEEN OBTAINED.

The Editor reserves to himself the right to decline to answer any question which is, in his judgment, unsuited to the Magazine.

Captain Cuttle.—A small magnet placed end-on at 1 m. from a declination magnetometer deflects it through 1°30′, and when placed end-on at 2m. from a bifilar magnetometer deflects it through seven divisions of its scale. Calculate the percentage of change in the horizontal component of the earth's magnetic intensity that is represented by each division of the scale of the bifilar, assuming its average value to be H = ·1811. [N.B.—tan 1°30′ = ·0262.]

(London University B.Sc. (Pass), 1897.)

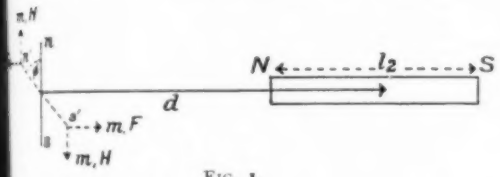


FIG. 1.

The meaning of the latter part of this question is as follows:—Suppose a magnet, supported by a bifilar suspension, to be hung so that its axis is at right angles to the earth's field, the average value of the latter being ·1811 dynes; then what percentage alteration in the earth's field will correspond to a motion of the suspended magnet through one scale division.

In the first place notice that with a bifilar suspension, the angular deflection will be proportional to the applied couple.

Let l = the length of the suspended magnet.

m = its pole strength.

H = the horizontal component of the earth's field in dynes.

Then force on either pole, due to earth's field, $= m\mathrm{H}$.

$\therefore$ deflecting couple $= m\mathrm{H} \times l = ml\mathrm{H}$.

Let θ = the corresponding deflection of the suspended magnet, measured in scale graduations.

$$\therefore ml\mathrm{H} = k\theta,$$

where k is a constant; this is an analytical expression of the statement that the angular deflection is proportional to the applied couple.

$$\mathrm{H} = \frac{k}{ml}\theta = \mathrm{K}\theta \quad . \quad . \quad . \quad . \quad (1)$$

$$\text{if } \mathrm{K} = \frac{k}{ml}$$

If now an increase of h in the value of H causes a further deflection of 1 scale division, we have

$$\mathrm{H} + h = \mathrm{K}(\theta + 1);$$
$$\therefore h = \mathrm{K}.$$

Now the percentage increase in the value of H will be equal to

$$\frac{h \times 100}{\cdot 1811}.$$

$\therefore$ Percentage alteration in the earth's field corresponding to a deflection through 1 scale division

$$= \frac{\mathrm{K} \times 100}{\cdot 1811} \quad . \quad . \quad . \quad . \quad (2).$$

It must be noticed that, in the above reasoning, it is assumed that the suspended magnet is only displaced through small angles; if this were not so, the value of the couple would depend not only on the earth's field, but also on the angle through which the magnet had been deflected. Indeed the couple would then have for value

$$m\mathrm{H} \times l \cos \phi,$$

where ϕ is the circular measure of the angular deflection. It follows from (2) that the only value which remains to be determined is that of K.

The determination is effected by producing a known field by means of another magnet. The magnitude of the field at any distance from a magnet can be calculated when the moment of the magnet is known. The moment is determined by the aid of the declination magnetometer. In this instrument the control is exercised by the earth's field.

Let ns (Fig. 1) represent the position of the magnetometer needle when acted on only by the earth's field (H), and let it be deflected through an angle ϕ to the position n_1s_1 when a perpendicular field F is generated in its vicinity by the presence of a larger magnet NS. Then equating the couples acting on the magnetometer needle (which is supposed to be of length l_1 and pole strength m_1) we have

$$m_1\mathrm{H} \times l_1 \sin \phi = m_1\mathrm{F} \times l_1 \cos \phi;$$
$$\therefore \mathrm{F} = \mathrm{H} \tan \phi \quad . \quad . \quad . \quad . \quad (3).$$

To determine F in terms of the magnetic moment of NS, let m_2 = the pole strength, and l_2 the length of NS. Let the centre of NS be at a distance d from the magnetometer needle; then

$$\mathrm{F} = \frac{m_2}{\left(d - \frac{l_2}{2}\right)^2} - \frac{m_2}{\left(d + \frac{l_2}{2}\right)^2} = m_2 \frac{2dl_2}{\left(d^2 - \frac{l_2^2}{4}\right)^2}$$

From the nature of the question, l_2 is assumed to be small in comparison with d. Hence

$$\mathrm{F} = \frac{2m_2l_2}{d^3}$$
$$= \frac{2\mathrm{M}}{d^3} \quad . \quad . \quad . \quad . \quad (4)$$

if $\mathrm{M} = m_2l_2$ = the magnetic moment of NS. Substituting from (4) in (3) we obtain

$$\frac{2\mathrm{M}}{d^3} = \mathrm{H} \tan \phi,$$

$$\therefore \mathrm{M} = \frac{\mathrm{H}d^3}{2} \tan \phi.$$

In the given problem—

$\mathrm{H} = \cdot 1811$;

$d = 100$ cm.;

$\phi = 1°30'$, and $\tan \phi = \cdot 0262$;

$$\therefore \mathrm{M} = \frac{\cdot 1811 \times (100)^3}{2} \times \cdot 0262 = 181100 \times \cdot 0131$$
$$= 2370.$$

This determines the magnetic moment of the deflecting magnet. Now since this magnet is afterwards placed end-on at a distance of 2 metres from the bifilar magnetometer, the field produced, from (4), will be equal to

$$\frac{2 \times 2370}{(200)^3} = \cdot 000592.$$

From (1) $\mathrm{H} = \mathrm{K}\theta$

$$\mathrm{H} + \cdot 000592 = \mathrm{K}(\theta + 7)$$
$$\cdot 000592 = 7\mathrm{K},$$
$$\therefore \mathrm{K} = \frac{\cdot 000592}{7} = \cdot 000085.$$

Finally, from (2), the percentage alteration in the earth's field corresponding to a single division of the bifilar magnetometer is given by

$$\frac{\mathrm{K} \times 100}{\cdot 1811} = \frac{\cdot 000085 \times 100}{\cdot 1811} = \cdot 047\ \%.$$

Enquirer.—The sum of the digits of a certain number, which is less than a thousand, is 23. Show that if the number be multiplied by 2, the sum of the digits of the product will be 19.

(Post Office. Telegraph Learners. Feb. 1897.)

Because the number is less than a thousand, it must have either *one*, *two*, or *three* digits; but because the sum is 23, it *can* have neither *one* nor *two* digits; hence it must have *three* digits.

On consideration it will be readily seen that no digit can be *less than* 5, from which it follows that, in the number obtained after doubling, there will be 4 digits, and the digit in the thousand's place will be 1.

Let the digits of the first number be x, y, z, and those of the second be a, b, c. By taking any number such as 887 and doubling it, you should have no difficulty in seeing that

$$2z = 10 + a$$
$$2y = 10 + b - 1$$
$$2x = 10 + c - 1$$
$$\therefore 2(x + y + z) = 30 + (a + b + c) - 2$$
$$46 = 28 + a + b + c$$
$$18 = a + b + c.$$
$$\therefore 1 + a + b + c = 19.$$

H. J. G.—A block of transparent jelly of refractive index 1·33 is bounded on one side by part of the convex surface of a sphere of radius 8 mm. Find the position of the principal focus within the mass of the material.

(Inter. Sci., Physics (Pass Exam.), July, 1898.)

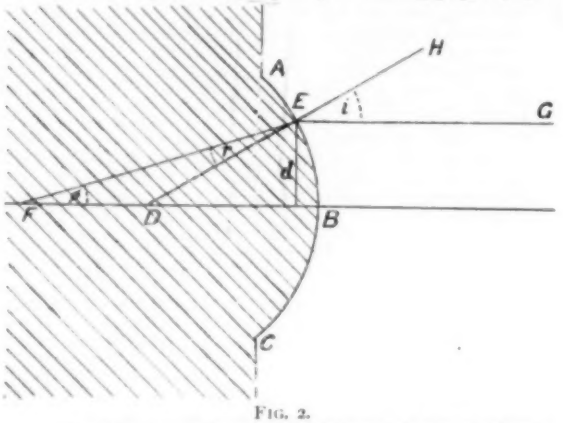


FIG. 2.

Let ABC (Fig. 2) be the part of the spherical surface bounding the jelly, the latter being situated to the left (shaded portion). Let D be the centre of curvature of the spherical surface. Let the object be at an infinite distance along the line DB produced to the right. Then GE will represent one of the parallel rays incident on ABC; the corresponding ray EF refracted into the jelly is also shewn. Then F is the position of the principal focus. To determine the position of F we must proceed as follows:—

Let i = circular measure of the angle of incidence, *i.e.*, GEH,

r = circular measure of the angle of refraction, *i.e.*, DEF.

Then $\sin i = \mu \sin r$.

Under the conditions holding with lenses, both i and r must be small; if this is not the case, no focus, but a caustic, is formed. Hence, taking the sine as equal to the circular measure of the angles

$$i = \mu r \quad . \quad . \quad . \quad . \quad (1).$$

Further, EDB = GEH = angle of incidence.

Let d = the length of a perpendicular from E on to FB. Let R = DB = DE = radius of curvature of spherical surface.

$$\therefore \frac{d}{R} = \sin \text{EDB} = \sin i = i \quad . \quad . \quad . \quad . \quad (2).$$

Let ϕ = circular measure of the angle EFB.

Then since the external angle of a triangle is equal to the two interior and opposite angles,

$$\angle \text{EDB} = \angle \text{EFB} + \angle \text{FED}.$$
$$i = \phi + r$$
$$\phi = i - r.$$

Let v = the distance of the focus within the jelly from the surface thereof.

Then in the limit, EF = v.

Also $$\frac{d}{v} = \sin \phi = \phi,$$

since ϕ must be small.

$$\therefore \frac{d}{v} = i - r = \frac{d}{R} - r.$$

$$\therefore r = \frac{d}{R} - \frac{d}{v} \quad . \quad . \quad . \quad . \quad (3).$$

Combining (2) and (3) with (1), we get

$$\frac{d}{R} = \mu \left\{ \frac{d}{R} - \frac{d}{v} \right\}$$

Then dividing through by d, and rearranging the terms

$$\frac{\mu}{v} = \frac{\mu - 1}{R}.$$

In the problem set,

$$\mu = 1{\cdot}33.$$
$$R = 8 \text{ mm}.$$

$$\therefore \frac{1{\cdot}33}{v} = \frac{{\cdot}33}{8};$$

$$\therefore v = \frac{8 \times 1{\cdot}33}{{\cdot}33} = 32{\cdot}3 \text{ mm}.$$

Hence the focus will be situated 32·3 mm. from the surface of the jelly.

A. W. B.—(*a*) If P and Q be middle points of a and b of a spherical triangle, prove $\cos \text{PQ} = \dfrac{1 + \cos a + \cos b + \cos c}{4 \cos \frac{1}{2} a \cos \frac{1}{2} b}$.

(*b*) From vertex C of a spherical triangle an arc p is drawn perpendicular to the base. Express $\sin p$ in terms of a, b, c, and C.

(2nd Arts, R.U.I.).

(*a*) Consider the fundamental formula,

$$\cos c = \cos a \cos b + \sin a \,.\, \sin b \cos \text{C} \quad . \quad . \quad . \quad . \quad (1)$$

$$\text{or } \cos \text{C} = \frac{\cos c - \cos a \,.\, \cos b}{\sin a \sin b} \quad . \quad . \quad . \quad . \quad . \quad . \quad (2)$$

Now in the triangle PQC we have the sides $\frac{a}{2}$, $\frac{b}{2}$, PQ taking the place of a, b, c in the triangle ABC, hence equation (1) becomes

$$\cos \text{PQ} = \cos \frac{a}{2} \,.\, \cos \frac{b}{2} + \sin \frac{a}{2} \,.\, \sin \frac{b}{2} \cos \text{C} \quad . \quad . \quad (3)$$

But (2) is still true for the triangle ABC, therefore substitute from (2) into (3), when (3) becomes

$$\cos \text{PQ} = \cos \frac{a}{2} \,.\, \cos \frac{b}{2} + \sin \frac{a}{2} \,.\, \sin \frac{b}{2} \left(\frac{\cos c - \cos a \,.\, \cos b}{\sin a \,.\, \sin b} \right)$$
$$= \cos \frac{a}{2} \,.\, \cos \frac{b}{2} + \frac{\cos c - \cos a \,.\, \cos b}{4 \cos \frac{a}{2} \,.\, \cos \frac{b}{2}}.$$

Simplify this by putting $1 + \cos a$ for $2 \cos^2 \frac{a}{2}$ and $1 + \cos b$ for $2 \cos^2 \frac{b}{2}$, and you obtain the required expression for cos PQ.

(*b*) Considering the triangle CAD right-angled at D, we have $\dfrac{\sin p}{\sin b} = \sin \text{A}$.

But in any triangle $\dfrac{\sin \text{A}}{\sin \text{C}} = \dfrac{\sin a}{\sin c}$.

Hence, $\sin p = \sin b \,.\, \sin \text{A} = \dfrac{\sin b \,.\, \sin a \sin \text{C}}{\sin c}$.

Plato.—If 18 cows eat the grass of a field of 16 acres in 14 days, and 15 cows eat the grass of 12 acres in 11 days, how long will it take 12 cows to eat the grass of 8 acres of the field?

(Haugh's 'Higher Arith.', Ex. 9, No. 23.)

This question assumes that the grass continues to grow uniformly.

By the term 'acre' we mean quantity on acre originally.

By the term 'acre-day' we mean growth per acre per day.

By the term, 'cow-day' we mean consumption per cow per day.

Writing the three statements of the question in terms of these expressions we have

16 acres +	16 × 14 acre-days	= 18 × 14	cow-days.
12 ,, +	12 × 11 ,,	= 15 × 11	,,
8 ,, + 8 (No. of days)	,,	= 12 × (No. of days)	,,

In order to obtain the same number of acres in each case the above may be written

48 acres +	16 × 42 acre-days	= 18 × 42	cow-days.
48 ,, +	12 × 44 ,,	= 15 × 44	,,
48 ,, + 48 (No. of days)	,,	= 72 (No. of days)	,,

Subtracting the *second* statement from the first we find that

144 acre-days = 96 cow-days;

or 1 ,, = $\frac{2}{3}$ of a cow-day;

which means that the *growth per acre per day* is $\frac{2}{3}$ of what a cow consumes in a day. Making use of this, the first statement above becomes

16 acres + ($\frac{2}{3}$ × 16 × 14) cow-days = 18 × 14 cow-days.

16 ,, = 18 × 14 − ($\frac{2}{3}$ × 16 × 14) = 102$\frac{2}{3}$,,

∴ 1 acre = 6$\frac{8}{12}$ cow-days.

The third relation now becomes

8 × 6$\frac{8}{12}$ cow-days + ($\frac{2}{3}$ of 8 × No. of days) cow-days = 12 (No. of days) cow-days;

or, $1\frac{5}{3}\frac{4}{4} + 5\frac{1}{3}$ (No. of days) = 12 (No. of days).

$1\frac{6}{3}\frac{4}{4} = 6\frac{2}{3}$ (No. of days).

∴ No. of days = $1\frac{6}{3}\frac{4}{4} \div 6\frac{2}{3} = \underline{7{\cdot}7 \text{ days}}$.

Mab wants to know if Second Class passes in Second Grade Drawing subjects count toward the full D. if gained in 1888. The answer is that such certificates do not count for the First Class Drawing Certificate, but they do count for the Full (Second Class) Drawing Certificate. This does not apply to Geometry and Perspective, which must be First Class to count at all.

M. P.—If any rational integral expression which contains x be equal to zero when $x = a$, prove that $x - a$ must be a factor of the expression. Hence prove that

$$(a+b)^2(a+c)^2(b-c)+(b+c)^2(b+a)^2(c-a)+(c+a)^2(c+b)^2(a-b)=(a-b)(a-c)(b-c)\{a^2+b^2+c^2+3(ab+bc+ca)\}$$

See PRACTICAL TEACHER, Oct. 1898 (Query Col.).

A.W.B.—(*a*) If $\tan\alpha = \tan\beta\tan\gamma$, prove that

$$\tan 2\alpha = \frac{\sin 2\beta \,.\, \sin 2\gamma}{\cos 2\beta + \cos 2\gamma}.$$

(*b*) If $\sin\theta + \sin\phi = x$, and $\cos\theta + \cos\phi = y$, find $\sin(\theta+\phi)$ in terms of x and y. (R. U. I., 2nd Arts.)

(*a*) $1 + \tan\alpha = 1 + \tan\beta \,.\, \tan\gamma = 1 + \dfrac{\sin\beta \,.\, \sin\gamma}{\cos\beta \,.\, \cos\gamma}$

$$= \frac{\cos\beta \,.\, \cos\gamma + \sin\beta \,.\, \sin\gamma}{\cos\beta \,.\, \cos\gamma} = \frac{\cos(\beta-\gamma)}{\cos\beta \,.\, \cos\gamma}$$

Similarly,

$$1 - \tan\alpha = \frac{\cos(\beta+\gamma)}{\cos\beta \,.\, \cos\gamma}.$$

Now $\tan 2\alpha = \dfrac{2\tan\alpha}{1-\tan^2\alpha} = \dfrac{2\tan\alpha}{(1+\tan\alpha)(1-\tan\alpha)}$

$$= \frac{2\tan\beta \,.\, \tan\gamma}{\cos(\beta+\gamma)\cos(\beta-\gamma) \div \cos^2\beta \,.\, \cos^2\gamma}$$

$$= \frac{4\sin\beta \,.\, \sin\gamma \,.\, \cos\beta \,.\, \cos\gamma}{2\cos(\beta+\gamma)\cos(\beta-\gamma)}$$

$$= \frac{\sin 2\beta \,.\, \sin 2\gamma}{\cos 2\beta + \cos 2\gamma}.$$

(*b*) Multiply the two together, and we have

$$\sin\theta\cos\theta + \sin\phi \,.\, \cos\phi + \sin(\theta+\phi) = xy$$

$$\tfrac{1}{2}(\sin 2\theta + \sin 2\phi) + \sin(\theta+\phi) = xy$$

$$\sin(\theta+\phi) \,.\, \cos(\theta-\phi) + \sin(\theta+\phi) = xy$$

$$\sin(\theta+\phi)[1+\cos(\theta-\phi)] = xy \quad \ldots\ldots (1)$$

Now square the two equations and add; we get

$$\sin^2\theta + \cos^2\theta + \sin^2\phi + \cos^2\phi + 2\cos(\theta-\phi) = x^2 + y^2$$

$$2[1+\cos(\theta-\phi)] = x^2 + y^2 \,. \quad (2)$$

Hence $$\sin(\theta+\phi) = \frac{2xy}{x^2+y^2}$$

J. Junor.—The solution given to your query in the November PRACTICAL TEACHER, 1898, involves a misinterpretation.

Since each day the man spends as many sixpences as the total number of days in his holidays, the solution is simply

(number of days)($\frac{1}{2}$ number of days) = 1152.

$\therefore$ No. of days = $\sqrt{2304} = 48$.

E. M. Spiller.—Your solution is correct.

Scholarships.—If a straight line is divided internally in medial section, and from the greater segment a part is taken equal to the less: show that the greater segment is also divided in medial section. (Hall and Stevens, p. 146.)

Let AB be the given line divided internally in medial section at C; then

$$AB \,.\, BC = AC^2.$$

Take D on CA such that CD = CB, then we have to show that

$$AC \,.\, AD = CD^2; \text{ (\textit{not} } AC \,.\, CD = AD^2).$$

Now $AC \,.\, AD = AC\,(AC - CD)$

$= AC^2 - AC \,.\, CD$

$= AC^2 - AC \,.\, CB$

$= AB \,.\, BC - AC \,.\, BC$

$= (AC + CB)\,CB - AC \,.\, BC$

$= CB^2 = CD^2$; Q.E.D.

J. G. E.—Prove that

$$\frac{\sin 7\alpha}{\sin\alpha} = 1 + 2\cos 2\alpha + 2\cos 4\alpha + 2\cos 6\alpha.$$

(S. and A. Exam., Stage 3.)

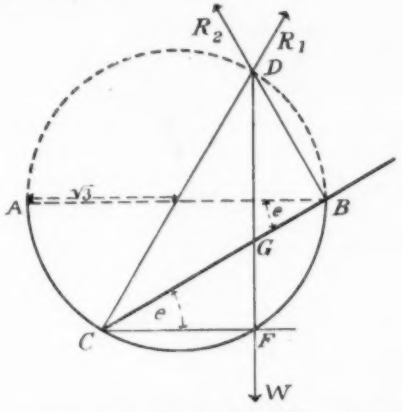
When there is a series of terms of cosines or sines in which the angles are in A.P., and the coefficients are equal, the rule is to multiply and divide by sin (half the common difference). Thus—

$$\text{L.H.S.} = \frac{\sin\alpha + 2\sin\alpha\cos 2\alpha + 2\sin\alpha\cos 4\alpha + 2\sin\alpha\cos 6\alpha}{\sin\alpha}$$

$$= \frac{\sin\alpha + (\sin 3\alpha - \sin\alpha) + (\sin 5\alpha - \sin 3\alpha) + (\sin 7\alpha - \sin 5\alpha)}{\sin\alpha}$$

$$= \frac{\sin 7\alpha}{\sin\alpha}; \text{ Q.E.D.}$$

Perseverando.—A uniform rod 4 inches in length is placed with one end inside a smooth hemispherical bowl, of which the axis is vertical and the radius $\sqrt{3}$ inches long. Find how much of the rod will project over the rim.



Let θ denote the inclination of the rod to the horizon, the reaction R_2 at B is at right angles to the rod, and the reaction R_1 at C is perpendicular to the tangent at C: the three forces keeping equilibrium are W (acting through the middle point of the rod), R_1, and R_2; these must all pass through one point D; also, as DBC is a right angle, point D lies on the circumference of the completed circle.

If CF be drawn parallel to AB, $\therefore$ perpendicular to the line of action of W, then CFG is a right angle and F lies on the circle CFB: also, CF is parallel to AB. Hence angle GCF = θ. Applying the usual conditions of equilibrium,

$\therefore$ Resolving along the rod,

$$R_1\cos\theta = W\sin\theta. \quad (1)$$

Resolving perpendicular to the rod,

$$R_2 + R_1\sin\theta = W\cos\theta. \quad (2)$$

Next take moments about C.

$$W \times CF = R_2 \times BC.$$

Let $2l$ denote the length of the rod.

Then $W \times CF = W \times l\cos\theta$,

and $R_2 \times BC = R_2 \times 2r\cos\theta$,

where r = radius of bowl.

$\therefore$ $Wl\cos\theta = R_2 \times 2r\cos\theta$,

or $Wl = 2R_2r$. (3)

From (1) $R_1 = W\tan\theta$. (4)

Substitute this value for R_1 in (2).

$\therefore$ $R_2 = W\cos\theta - W\tan\theta\sin\theta$,

or $\dfrac{R_2}{W} = \cos\theta - \dfrac{\sin^2\theta}{\cos\theta} = \dfrac{\cos^2\theta - \sin^2\theta}{\cos\theta}$.

From (3) $\dfrac{R^2}{W} = \dfrac{l}{2r}$

$\therefore$ $\dfrac{l}{2r} = \dfrac{\cos^2\theta - \sin^2\theta}{\cos\theta}$.

Solving this quadratic for $\cos\theta$ we obtain

$$\cos\theta = \frac{l \pm \sqrt{32r^2 + l^2}}{8r}.$$

But $l = 2$ and $r = \sqrt{3}$,

$$\therefore \cos\theta = \frac{2 \pm \sqrt{32\times 3 + 4}}{8\sqrt{3}} = \frac{2+10}{8\sqrt{3}} = \frac{6}{4\sqrt{3}} = \frac{\sqrt{3}}{2},$$

or $\theta = 30°$.

(The negative value is inadmissible, as the angle cannot exceed 90°.)

The length $BC = 2r\cos\theta = \dfrac{2\sqrt{3}\times\sqrt{3}}{2} = 3''$.

Hence one inch of the rod will project over the rim.

See Rule 1, *Query Column.*

Scot.—As the examination is competitive it is difficult to give a decided answer to your query. It is, however, very unlikely that four advanced and four elementary successes would suffice. At least the Honours stage should be attempted, and as few elementary stages as possible—none preferably. It is quite impossible to give a minimum.

Perplexed One.—As marks in Geography and History are not carried forward to the Certificate Examination, candidates are practically compelled to take these subjects, even though they have passed with credit in them at the Queen's Scholarship Examination. Candidates may take Geography, History, *and* two Sciences, *and* two Languages, *i.e.* six subjects in all, at the Certificate Examination.

A. H. H.—A person buys 6 per cent. bonds, the interest on which is payable yearly, and which are to be paid off at par 3 years after the time of purchase; if money be worth 5 per cent., what price should be given for the bonds?

(Pendlebury, Ex. CLXV., No. 65.)

See Query Column, PRACTICAL TEACHER, April, 1897, p. 600.

Cattock.—How many different numbers can be formed by using one or more of the figures 1, 2, 3, 4, 5. ('P. T.,' 1894.)

Assuming that no number contains two or more like digits, the solution is as follows:—

Numbers containing one digit, *five*.

" " two digits ${}_5P_2 = 5 \times 4 = 20$.
" " three " ${}_5P_3 = 5 \times 4 \times 3 = 60$.
" " four " ${}_5P_4 = 5 \times 4 \times 3 \times 2 = 120$.
" " five " ${}_5P_5 = 5 \times 4 \times 3 \times 2 = 120$.

Total 325.

St. Ives.—Find a line such that three times the rectangle contained by it and a given line is equal to the sum of the squares on the two lines.

(Queen's Scholarship, 1897, Euclid Paper, No. 6.)

Suppose that the given line is of length a: then we have to find a line of length x, such that

$$a^2 + x^2 = 3ax,$$

or $$a^2 - 2ax + x^2 = ax,$$

or $$(a - x)^2 = ax.$$

That is, we have to find a line such that the rectangle (ax) contained by it and the given line is equal to the square on the difference $(a - x)$ between the two lines.

Referring to Euc. II. 11 find C such that

$$AB.BC = AC^2,$$

then clearly will $AB.BC = (AB - BC)^2$, (*i.e.* AC^2);

hence BC, so found, is the required line.

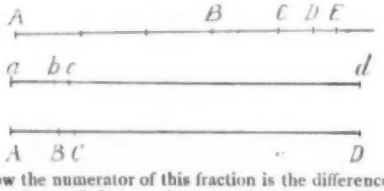
For then $AB.BC = CA^2 = AB^2 - BC^2 - 2AC.CB$ (Euc. II. 4)
$= AB^2 - BC^2 - 2(AB - BC)CB$
$= AB^2 - BC^2 - 2AB.BC + 2BC^2$;
$\therefore 3AB.BC = AB^2 + BC^2$; Q.E.D.

Robert Scott.—The price of wine being raised 6d. a bottle, three bottles less than before can be bought for 4 guineas. What is the present price? (Ans. 4s.)

(Blackwood's Higher Arith. Miscellaneous, Exs. No. 47.)

Suppose that a line ad is divided into 16 equal parts, of which ab is one; also into 12 equal parts, of which ac is one. Then

$$bc = ac - ab = \left(\frac{1}{12} - \frac{1}{16}\right) \text{of } ad = \frac{4}{12 \times 16} ad.$$



Now the numerator of this fraction is the difference between the numbers of the equal parts, 16 and 12; while the denominator is the product of these numbers.

Let AD represent 4 guineas, or 168 sixpences. Suppose that AB is the first price per bottle, and AC the second price. We know that BC $= \frac{1}{168}$ of AD; also from the above it will be seen that BC is a certain fraction of AD, having 3 for its numerator and the product of two whole numbers which differ by 3 for its denominator.

Hence $$\frac{1}{168} AD = \frac{3}{(\text{Number})(\text{Number} + 3)} AD.$$

Therefore 3×168, or 504, is the product of two numbers differing by 3. By observing the factors of 504, the required numbers are seen to be 21 and 24, and $\frac{1}{21}$ of 84 shillings, or 4 shillings is the required price.

Trig.—A straight line cuts three concentric circles in A, B, C, and passes, at a distance ρ, from their centres. Show that the area of the triangle formed by the tangents at A, B, C, is

$$\frac{BC \cdot CA \cdot AB}{2\rho}.$$

(Hall and Knight's Trig., Exs. xviii. 6, No. 32.)

Draw a figure according to the following instructions:—

Let O be the centre of the circles (radii r_1, r_2, r_3), and let A be on the smallest circle. Produce CA, and draw ON perpendicular to this line; then $ON = \rho$. Let the tangent at A meet those at B and C in D and E respectively; also let the tangents at B and C intersect in F. Then we require to find the area of DEF. Join O to A, B, C.

Let the angles BOA and COA be ϕ and θ respectively; then BDA and CEA are also ϕ and θ, so that EFD is $\theta - \phi$.

Knowing all the angles of the triangle DEF, we shall aim at finding one side, namely, ED.

Now $$\frac{AD}{AB} = \frac{\sin DBA}{\sin \phi} = \frac{\cos OBN}{\sin \phi} = \frac{BN}{r_2 \sin \phi}.$$

$\therefore AD = AB \cdot BN \div r_2 \sin \phi$.

Similarly
$$AE = AC \cdot CN \div r_3 \sin \theta.$$

$$\therefore ED = AE - AD = \frac{AB \cdot BN}{r_2 \sin \phi} - \frac{AC \cdot CN}{r_3 \sin \theta}.$$

But $$\frac{AB}{r_2} = \frac{\sin \phi}{\rho \div r_1}; \quad \frac{AC}{r_3} = \frac{\sin \theta}{\rho \div r_3}; \quad \frac{CB}{r_3} = \frac{\sin(\theta - \phi)}{\rho \div r_2}$$

Hence $$ED = \frac{r_1 CN}{\rho} - \frac{r_1 BN}{\rho} = \frac{r_1 CB}{\rho}.$$

Using the formula $\frac{a^2 \sin B \cdot \sin C}{2 \sin A}$ for the area of a triangle,

we have area of $$DEF = \frac{ED^2 \cdot \sin\theta \cdot \sin\phi}{2\sin(\theta - \phi)}$$
$$= \frac{r_1^2 CB^2}{\rho^2} \cdot \frac{\sin\theta \sin\phi}{2\sin(\theta - \phi)}$$
$$= \frac{BC \cdot CA \cdot AB}{2\rho}$$

by substituting for $\sin\theta$, $\sin\phi$, $\sin(\theta - \phi)$ from the three equations arranged in one line above.

M. P., Singapore.—What chemical changes take place in a skeletal muscle when thrown into action?

When a muscle is quiescent, as in all living tissues, a small quantity of oxygen is being constantly absorbed and a small quantity of carbon dioxide liberated. When the muscle is thrown into action, there is a much increased formation of CO_2 and increased absorption of oxygen. Also, an acid reaction occurs owing to the formation of sarcolactic acid ($C_3H_6O_3$). It is believed that some form of carbohydrate is of great importance in contraction, becoming broken up into CO_2 and lactic acid. The blood leaving a group of muscles which are kept in contraction contains less sugar than that entering the muscles. It is possible that sugar ($C_6H_{12}O_6$) is the special carbohydrate food of muscle, and by its oxidation forms the chief source of energy set free when a muscle is thrown into action and does work.

Twelve.—What numbers of 4 digits each can have 119 as their G.C.M. and 13923 as their L.C.M.?

('Solution of Difficulties in Arithmetic,' Moffat and Paige.)

Take any two numbers, say 125 and 325. What is their L.C.M. and what their G.C.M.? How are the two related?

$$25)125 \quad 325$$
$$5 \quad 13$$

$\therefore$ L.C.M. $= 25 \times 5 \times 13$,
G.C.M. $= 25$.

That is, we observe that the L.C.M. divided by the G.C.M. gives the product of those two numbers (5 and 13), which are obtained by dividing the given numbers by their G.C.M.

Hence, $13023 \div 119$, gives 117, which corresponds with the 5×13 above. Now the factors of 117 are 117 and 1, 3 and 39, 9 and 13.

If the required numbers are to each have 4 digits, we must take 9 and 13, and these, multiplied by the G.C.M. give 9×119, and 13×119, or 1071 and 1547.

A correspondent has very kindly written us with respect to an edition of Livy XXXIII.:—'This is the book set for 1st University Examination of Royal University of Ireland, and I had a good deal of hunting for it. It is published by Sullivan Brothers, Booksellers, Dublin, and by Simpkin, Marshall & Co., London, with Vocabulary and Notes by Rev. Mr. Rice, B.D., price 3s.; also Key 2s. Excellent books.'

OUR SCIENCE SECTION

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NOTES ON PHYSIOLOGY:

EMBRACING THE SUBJECTS OF THE ADVANCED AND HONOURS STAGES, SCIENCE AND ART DEPARTMENT.

BY WALKER OVEREND, M.A., M.D. (OXON), B.SC. (LONDON),

Physician to the Tottenham Hospital;
Late Radcliffe Fellow, Scholar of Balliol College, and Exhibitioner in Comparative Anatomy of the London University.

The Properties of Milk.—*Milk* is an opaque-white or yellowish-white fluid. The colour and opacity are due to its being an emulsion, that is, to its consisting of minute globules of fat suspended in a solution of albumin, sugar, and certain salts. Each globule of milk is contained in an envelope of casein. When milk is allowed to stand the fat globules rise to the top and form *cream*. When kept at a summer temperature the milk sugar, after some hours, becomes converted by fermentation into lactic acid, which imparts to the milk an acid reaction, and at the same time precipitates the *casein*. The milk is then said to curdle. The *curd* or coagulum encloses the fat globules, and the liquid in which the curd is contained is the *whey*, and consists of unfermented milk sugar and salts.

Microscopical Examination.—Examine under the low power of the microscope and observe the numerous minute fat globules. Place over a cover glass and draw under it a few drops of dilute acetic acid, the globules will coalesce, as the albuminous (casein) envelopes are dissolved.

Reaction.—Test with litmus paper. It is generally alkaline.

Constituents of Milk.—(1) *Casein.* (A) Dilute the milk with water and add a little acetic acid. Warm to 40° C. and filter. Keep the filtrate. (B) The casein remains on the filter, wash it with warm water, and a little ether. The filtrate B contains albumin, milk-sugar, and salts.

(2) To test it for *Albumin.* 1. Boil a small quantity in a test-tube, a precipitate is produced which is albumin. 2. Add to another portion a little strong nitric acid and boil. The liquid becomes yellow. Allow to cool and add ammonia, when the colour becomes much darker. This is a test to which all albuminous substances respond. It is termed the *Xantho-proteic* Reaction.

(3) *Milk Sugar.*—Boil a portion of filtrate B to coagulate the albumin, and filter.

Add a solution of copper sulphate to one portion and an excess of solution of potash. Boil, when a yellowish red precipitate falls. This precipitate is the red oxide of copper (Cu_2O).

Evaporate another portion of the solution in a water-bath until it becomes syrupy. Then stand for a time and milk sugar will crystallize out in rhombic prisms.

(4) *The Inorganic Salts* are chlorides, sulphates, and carbonates of sodium, potassium, and calcium.

To test for chlorides add silver nitrate to the filtrate from the albumin; a white precipitate of silver chloride is formed, soluble in ammonia.

To test for sulphates add a little hydrochloric acid and barium chloride; a white precipitate of barium sulphate is produced.

The Fats (butter) may be separated by adding a strong solution of potash to twice the same quantity of milk in a test-tube, then shaking with ether. The potash dissolves the casein of the fat globules, then the ether takes up the fat. Allow to stand, when the ether rises to the top. Remove this with a pipette and evaporate *of the ether, when the fat remains.*

The Urine is a clear liquid of a yellow colour with a specific gravity varying from 1,015 to 1,025, counting the specific gravity of water as 1,000. The reaction in a healthy state is acid.

When allowed to stand for a few hours normal urine deposits a slight sediment, called the *mucous cloud*. When allowed to stand in an open vessel for two or three days, the reaction of urine becomes alkaline, due to the conversion of the urea into carbonate of ammonium; also it emits a strong ammoniacal odour, and becomes cloudy, in consequence of certain salts, as phosphate of calcium, phosphate of magnesium and ammonium, becoming precipated.

The normal urine consists of two soluble ingredients chiefly, viz., urea and chloride of sodium. Besides these there are present, in small quantities only, hippuric acid, uric acid, sulphate of sodium, phosphates of calcium and magnesium, acid phosphate of sodium, and pigment.

The average amount of urine passed in 24 hours is about 50 ounces or 1,500 grammes. The daily excretion of the various constituents is as follows:—

Urea - - - -	33 grammes
Uric acid - - -	0·5 ,,
Hippuric acid - -	0·4 ,,

Preparation of Urea from Urine.—The urine is first evaporated on a water-bath to a small bulk (about one 6th), allowed to cool, and strong nitric acid is now added in excess. Crystals of nitrate of urea are deposited gradually.

To obtain the pure urea collect the crystals and dry them between filter paper, then place in mortar and add to them barium carbonate and ethylic alcohol in excess. Thoroughly mix them by means of the pestle, then dry the mass on a water-bath and add alcohol again. Filter after a time, and allow to evaporate, crystals of urea are left.

Dissolve a small quantity of the crystals in distilled water, and add a solution of hypobromite of sodium ($NaBrO$). An evolution of gas consisting of nitrogen (the hypobromite absorbs the CO_2) occurs owing to the decomposition of the urea. The oxygen of the hypobromite converts the CO of the urea into CO_2, and the hydrogen into water liberating the nitrogen. this CON_2H_4 becomes CO_2, $2H_2O$, and N_2. One of the methods of determining the amount of urea in urine is based on this reaction. One of the simpler forms of apparatus (*e.g.*, that of Doremus, graduated in cubic centimetres, and sold for about 3s. 6d.) should be used, and the method demonstrated to the class. The nitrogen is collected in a graduated cylinder and measured. 35·5 cubic centimetres of nitrogen correspond to the gramme of urea.

Preparation of Uric Acid from Urine.—Place 200 cubic centimetres of urine in a narrow glass cylinder and add 3 cubic centimetres of *pure* nitric acid. Allow to stand for 24 hours. On examination of the bottom and sides of the vessel dark brown crystals are found, which consist of uric acid.

Test for Uric Acid.—Pour off the urine, place a small crystal on a white porcelain capsule, add a few drops of strong nitric acid and warm. Allow to cool and add a drop of ammonia, and a purple colour is produced. This is the *murexide* test.

To Determine the Nature of the Salts.—(1) Add to urine in a test-tube a solution of silver nitrate. A precipitate of chloride and phosphate of silver is thrown down. Add a little nitric acid, this dissolves the phosphate of silver, and leaves the white curdy chloride of silver ($AgCl$).

(2) To urine add nitric acid and solution of barium chloride. A white precipitate of sulphate of barium ($BaSO_4$) falls, indicating the presence of *sulphates.*

(3) Add a few drops of urine to an acid solution of ammonium molybdate and boil. The fluid becomes yellow, and a yellow precipitate of phospho-molybdate of ammonium falls, showing the presence of *phosphates.*

(4) To 15 cubic centimetres of urine add 5 cubic centimetres of solution of lead acetate. A precipitate falls consisting of chloride, sulphate and phosphate of lead falls down. On settling the fluid is nearly decolorised, showing the presence of *pigment.*

The chief pigment of the urine and which imparts to it the yellow colour is termed urobilin. It is derived from the decomposition of the red colouring matter of the blood—haemoglobin.

The acid reaction of urine is not due to the presence of any free acid but to that of acid sodium phosphate.

CHEMISTRY NOTES.

BY THOMAS CARTWRIGHT, B.A., B.SC. (LOND.),
First Class Honourman in Chemistry (Science and Art Department), Head Master, Finchley School of Science, and Lecturer therein on Chemistry.

Separation of Sulphides, Sulphites, Sulphates, and Thiosulphates in the presence of each other.—The following is a summary of a very good method for the accomplishment of this somewhat difficult separation. The authors of this scheme are Messrs. Philip K. Browning and Ernest Rowe, and a full account of the pro's and con's of the separation appears in the *Chemical News* for Oct. 28th. 'To about 0·1 gram of the substance to be analysed, dissolved in 10 c.m. of water or more, add sodium, potassium, or ammonium hydroxide to distinct but faintly alkaline, reaction. The solution should be neutral or alkaline rather than even faintly acid, owing to the readiness with which sulphur separates. To the alkaline solution add zinc acetate in distinct excess, and filter. The precipitate may be tested for hydrogen sulphide on acidifying in the usual manner. To the filtrate add acetic acid, a few drops in excess of the amount necessary to neutralise, and barium chloride, and filter through a double filter. To the filtrate add iodine, until the solution takes on a permanent yellow tinge, and then bleach with stannous chloride—best after adding a few drops of hydrochloric acid, to prevent the possible precipitation of a basic salt of tin. A precipitate at this point indicates the sulphite. Filter; add bromine water in faint excess to the filtrate, bleaching again with stannous chloride. A precipitate on adding bromine indicates a thiosulphate originally present.'

Properties of Calcium.—Much interest attaches to the metal calcium just at this present, mainly because of its recent preparation in crystalline form by the great French chemist Henri Moissan. This chemist has recently described the properties of calcium, his description being mainly as follows:—The melting point, as determined by a thermo couple was 760° C. It is not difficult to cut metallic calcium, which, however, is much less malleable than potassium or sodium since it can be broken, when it exhibits a crystalline fracture. The colour of the metal when free from its nitride is a white, rivalling that of silver. Calcium will scratch lead, but not calcite. Its density is about 1·85. At fairly high temperatures it combines with the halogens chlorine, bromine, and iodine to form the corresponding haloid salts, although there is no reaction between calcium and the halogens in the cold. In oxygen the metal burns with dazzling brilliance and with the evolution of so much heat as to volatalise a part of the quicklime formed in the reaction. Both oxide and nitride are formed when the metal is burnt in the air. With carbon, calcium combines, at a dull red heat, to form the now well-known carbide of calcium (CaC_2). Another remarkable property of calcium is the power it possesses of reducing the most stable oxides at high temperatures. It sets free oxygen from sulphur dioxide, phosphoric anhydride, boron trioxide, silica, and the two oxides of carbon.

The Kinetic Theory of Gases.

Prof. Ramsay contributes a very readable article to the November *Contemporary Review* under this title, from which we make the following extracts:—

Rate of Molecular Motion in Gases.—'A molecule of hydrogen, if it moved in a straight line, unimpeded in its motion by collision with any other body, would pass through no less than **1¼ miles per second.** And a molecule of oxygen, equally free to move, would travel through space with a velocity of rather less than a third of a mile per second.'

At Rest.—'These rates of motion are calculated from the temperature of melting ice . . . . Is there any possibility of so lowering the temperature that the motion of such moving molecules will cease? Judging by the rate at which the pressure of a gas decreases with fall of temperature, there is. That temperature has been called the "absolute zero of temperature"; it lies 273° below the melting point of ice . . . . This temperature has not been reached; it is unlikely that it ever will be, but an approach has recently been made to it by liquefying hydrogen and allowing it to boil at the atmospheric pressure. The temperature reached in this manner is about −243° C.'

Argon and Helium Monatomic.—Prof. Ramsay refers to the fact that these two elements are regarded as monatomic because the ratio between their specific heats at constant pressure and constant volume is, as in the case of mercury, 1·61. 'Both of these elements possess one curious property, which they share with gaseous mercury alone, so far as is known, among all elements. That is technically called the ratio between their specific heats at constant pressure and at constant volume.'

The Two Specific Heats.—A word may appropriately be said as to the relation of (1) the kinetic theory of gases, and (2) the molecular constitution of certain gases, to the ratio between the two specific heats of gases, namely, the specific heat at constant pressure and the specific heat at constant volume.

If we heat a gas that is not allowed to expand, we find it requires less heat to take it through a certain temperature range than is required to take the same quantity of gas through the same temperature range when the gas is allowed to expand, *i.e.* when the pressure remains the same throughout the experiment

Explanation.—If we concede that a gas is a congeries of moving molecules, then when heat is applied and expansion takes place we must imagine the molecules to have been separated further apart by the heat, and to have been endowed with a greater amount of motion. Hence some of the applied heat has been used to do work on the molecules; some has been used in raising the temperature. The latter does, but the former does not, affect the thermometer. If by the application of pressure the separation is prevented, then the heat-energy formerly spent in driving the molecules apart is no longer expended in this way; hence a greater proportion of the heat makes itself evident as temperature, *i.e.* the specific heat is less at constant volume than it is at constant pressure. The ratio between the two is 1 : 1·67, about.

Mercury, Argon, and Helium normal, other Gases anomalous.—It is found that the specific heat of these three gases at constant pressure is 1·67 times its specific heat at constant volume; whereas the ratio between the two specific heats of other gases is considerably less than theory demands, as the following figures show:—

Ratio between the two specific heats
- (1) air = 1·405
- (2) oxygen = 1·397
- (3) hydrogen = 1·407
- (4) carbon dioxide = 1·309
- (5) ammonia = 1·299.

If we grant that the specific heat at constant pressure is normal, then the specific heats at constant volume of all gases except mercury, argon, and helium are too high; *i.e.* more heat is required to raise the temperature at constant volume than theory requires. Some of the heat, then, must do some sort of work upon the molecule of the imprisoned gas so as to become incapable of expressing itself as temperature. This brings us to the important point from the chemist's point of view.

Inter-molecular Motion—The only imaginable work that can be done is increasing the motion of the atoms in the molecule, the atoms being supposed to move round a common centre, which motion is rendered more rapid by the application of heat. It follows that, if we can conceive a molecule consisting of one single atom only, this inter-molecular motion will, in that and similar cases, be impossible, so that no heat would be used up for this purpose. All the heat applied to the gas would express itself as temperature, and the specific heat at constant volume would naturally be much less, and the ratio between the two specific heats much greater, in the case of simple molecules consisting of one atom than in the case of more complex molecules. Hence it is believed that mercury, argon, and helium are monatomic, which assumption fully accounts for the high ratio, 1·67, obtaining between the two specific heats of these three simple-molecule gases.

Helium and Argon and the Periodic Table.—Prof. Ramsay in his article proceeds to discuss the position of helium and argon in the Periodic Table. He gives only a few of the vertical columns, in which he disarranges the elements somewhat, as compared with the ordinary mode of arranging:—

Hydrogen	1	Helium	4	Lithium	7
Fluorine	19	Neon	19·2	Sodium	23
Chlorine	35·5	Argon	40	Potassium	39
Manganese	55	Iron, Cobalt, Nickel	56, 58, 59	Copper	63·5
Bromine	80	?		Rubidium	85.

Prof. Ramsay then proceeds to describe his hunt for a new element, of which hunt particulars have already appeared in this place (Sept. 1898).

His Summary.—'We have seen, then, that the discovery by Lord Rayleigh of a discrepancy in the density of atmospheric nitrogen has resulted in the discovery of a new constituent of air, argon; its discovery has led to that of a constituent of the solar atmosphere, helium; the necessary existence of an undiscovered element was foreseen, owing to the usual regularity in the distribution of the atomic weights of elements not being attained in the case of helium and argon; and the source of neon was therefore indicated. This source, atmospheric air, was investigated, and the missing element was discovered. A new fact has been added to science, and one not disconnected from others, but one resulting from the convergence of many speculations, observations, and theories brought to bear on one another.'

In a lecture given to the students of the Pharmaceutical Society Prof. Ramsay prophesies that another member of the argon group is in existence, further adding that it is a liquid element.

The Density of Ozone.—In the *Berichte* for November, an account is given of the redetermination of the density of ozone by Professor Ladenburg. To get the gas as pure as possible ozonised oxygen was cooled in a tube surrounded by liquid air. In order to remove liquid oxygen, nine-tenths of the liquid oxygen thus produced was allowed to evaporate, the result being that 2 or 3 c.c. of a blue-black opaque liquid were obtained, which was evaporated, and the gas thus obtained was tested in two portions in order to find, (1) its density, and (2) the proportion of ozone contained in it. The former was determined by ascertaining the velocity of effusion, the trapping liquid used being water instead of mercury. The proportion of ozone was determined by the agency of potassium iodide and sodium thiosulphate. As compared with the density of oxygen taken as unity the density of ozone given by the experiment was 1·456. Considering the difficulty of the experiment this proportion is quite near enough to the theoretical one (1 : 1·5) to satisfy reasonable people. Incidentally, Professor Ladenburg discovered that water at ordinary temperature and pressure does not dissolve more than one hundredth part of its volume of oxygen. An attempt was made to determine the boiling point of liquid ozone, which appears to be —125° C., but immediately upon boiling, the liquid exploded with such violence as to reduce the whole apparatus to powder.

PHYSIOGRAPHY NOTES.

The Chemistry of the Stars.—This was the subject of the Presidential Address, given on Oct. 28th by Sir Norman Lockyer, before the members of the Birmingham and Midland Institute. There is much food for thought in the lecture, as the following extracts will show :—

(1) **Elements in Celestial Bodies.**—'The first important matter is that if we deal with the chemical elements as judged by the lines in their spectra, we know of the existence of **oxygen**, of **nitrogen**, of **argon**, representing one class of gases, in no celestial body whatever; whereas representing other gases, we have a tremendous demonstration of the existence of **hydrogen** and **helium**.

'Among the non-metals there is a considerable development of **carbon** in some stars, and an indication of **silicon** in others, while among the metals are found chiefly **calcium**, **strontium**, **iron**, and **magnesium**.'

(2) **Three Main Groups of Stars.**—Sir Norman gave an interesting account of these groups, which may be summarised as follows :—

I. Gaseous stars—Highest temp.	Strong helium, faint enhanced lines, longest spectrum.
II. Metallic stars—Medium temp.	Feeble helium, and strong enhanced lines, medium spectrum.
	No helium, strong arc lines.
III. Carbon stars—Lowest temp.	Faint arc lines, shortest spectrum.

3. **The Chemical Law.**—'What then is the chemical law? It is this: In the very hottest stars we deal with the gases hydrogen, helium, and, doubtless, others still unknown, almost exclusively. At the next lowest temperatures we find these gases being replaced by metals in the state in which they are observed in our laboratories when the most powerful jet-spark is employed. At a lower temperature still, the gases disappear almost entirely, and the metals exist in the state produced by the electric arc. Certain typical stars showing these chemical changes may be arranged :—

Stars getting hotter.	Hottest stars.	Stars cooling.
ζ Tauri	B Hatrix	β Persei
Rigel		γ Lyra
α Cygni		Castor
γ Cygni		Procyon
α Orionis		Arcturus and Sun.'

The Absorbent Layer.—The Indian eclipse proved that, for some unknown reason, the lower and the upper parts of the sun's atmosphere do not absorb nearly so much as the middle layer, so that 'the absorption which defines the spectrum of a star is the absorption of a middle region, one shielded both from the highest temperatures of the lowest reaches of the atmosphere, where most tremendous changes are going on, and the external region, where the temperature must be low, and where the metallic vapours most condense. . . . . So far I have only dealt with the hotter stars, but I have pointed out that there are two distinct kinds of coolest ones, the evidence of their much lower atmosphere being the shortness of their spectra. In one of these groups helium, hydrogen, and the metals have practically disappeared, and we deal with carbon absorption alone.

The other Group.—'But the other group of coolest stars presents us with quite new phenomena. We no longer deal with absorption alone, but accompanying it we have radiation, so that the spectra contain both dark lines and bright ones.

'Now, since such spectra are visible in the case of **new stars**—the ephemera of the skies—which may be said to exist only for an instant, relatively, and when we find their places occupied by nebulæ, after the disturbance that gives rise to their sudden appearance has ceased, we cannot here be dealing with stars like the sun, which has already taken some millions of years to slowly cool, and requires more millions to complete the process into invisibility.

'The bright lines seen in the large number of permanent stars which resemble these fleeting ones—**new stars**, as they are called—are those discerned in the once mysterious nebulæ, which differ from stars generally in the fact that in their spectra we have practically to deal with radiation alone, we study them by their bright lines, the conditions by which we study the chemistry of the hottest ones are absent.'

A new View of Stars.—'Here then we are driven to the perfectly new idea that some of the cooler bodies in the heavens—the temperature of which is increasing, and which appear to us as stars—are really **disturbed nebulæ**.'

The Chemistry of the Nebulæ.—'They are mainly gaseous: the lines of helium and hydrogen and the flutings of carbon, already studied by their absorption in the groups of stars to which I have already referred, are present as bright ones. The presence of the lines of the metals iron, calcium, and probably magnesium, shows that we are not dealing with gases merely.'

A new View of Nebulæ.—'The nebulæ are cool collections of some of the permanent gases and of some cool metallic vapours; and both gases and metals are precisely those writing their records most visibly in stellar atmospheres. . . . A discussion of all the available observations, in my mind, demonstrates the truth of the suggestion that the nebulæ are masses of meteorites rendered hot by collisions.'

Steps in Celestial Evolution.—This was the last section of Sir Norman's highly interesting address: 'These are, shortly, that at first collisions produce luminosity among the colliding particles of the swarm, and the permanent gases are given off and fill the interspaces. As condensation goes on, the temperature at the centre of condensation always increasing, all the meteorites in time are driven into a state of gas. The meteoric bombardment practically now ceases for lack of material, and the future history of the mass of gas is that of a cooling body, the violent motions in the atmosphere while condensation was going on being replaced by a relative calm.'

This 'meteoric hypothesis' of Sir Norman is not accepted by astronomers in general, but Sir Norman stands to his guns, and says 'I have nothing to take back from what I have said;' furthermore, he claims that recent discoveries down to the eclipse of 1898 corroborate his views.

Bode's Law and Witt's Planet, D. Q.—In *Nature*, for November 3, Mr. W. J. S. Lockyer writes an interesting article on our newly discovered nearest neighbour, as we have already shown the tiny planet discovered by Witt to be. By way of preface Mr. Lockyer shows how Bode's Law led up to the search for a planet between Mars and Jupiter, with the result that Piazzi, of Palermo, happed upon Ceres, and so began the list of discoveries that has given us 425 planetoids or asteroids, the *débris*, it is believed, of a large planet formerly revolving in an orbit between those of Mars and Jupiter. The discovery of Neptune in 1846 set at naught Bode's Law, and so does D. Q., as the tiny planet just discovered is termed. Indeed, Bode's Law does not even suggest a number for the new planet, as there is no break between the distance accorded to earth and Mars, according to Bode's Law, which must be unreliable, or else D. Q. must be a minor planet gone somehow or other astray. Mr. Lockyer draws attention to the fact that 'the close approach of this planet to the earth at times of favourable opposition will give us excellent opportunity of determining more accurately than was possible before, the parallax of the sun—or, in other words, the distance of the sun from the earth.'

Elements of the New Planet.—Dr. Berberich, whose labours in this department have of late been so unremitting and so conspicuous, has not lost time in ascertaining and in publishing

the elements of Witt's planet D. Q. These elements are as given below :—

Epoch 1898, August 31·5—Berlin Mean Time.

	°	′	″	
Mean anomaly	220	14	3·7	
Perihelion distance from ascending node	178	28	26·2	1898·0.
Longitude of ascending node	303	48	53 0	
Inclination of orbit to that of the earth.	11	6	57 1	
Eccentricity	13	13	3·8	

Mean daily movement 2010″·131.

Period of revolution round the sun. 645 days.

Practical Petrology.—In connection with the late eruption of Vesuvius, Professor R. V. Matteucci has initiated some very interesting experiments in petrology. These consist in cooling artificially portions of flowing lava in order to check, either partially or wholly, the crystallisation of the substances contained in their magma, by which means it was sought to obtain information as to the exact stages at which different minerals separate out from the first exit of the lava up to its final consolidation.

The Accepted Altitude of the Aurora Borealis.—Professor Cleveland Abbe stated before the American Philosophical Society that some observers have seen the light in such positions between themselves and neighbouring objects as to demonstrate that the aurora, like lightning, may be entirely confined to the lowest stratum. Others have seen it so located among the clouds that its origin must be placed at or below their level, and therefore within a few thousand feet of the earth's surface. On the other hand, those who have calculated the altitudes of specific beams by trigonometrical or equivalent methods have deduced heights of twenty to a hundred miles; Dr. Boller has even quoted an altitude of 1243 miles. Professor Abbe remarks that, after reviewing the literature of the subject since the time of Halley, he finds that all methods agree in one fundamental assumption, that the observed beams and arches have an individual existence and a definite *locus*.

DIFFERENTIAL AND INTEGRAL CALCULUS FOR BEGINNERS.

FUNCTIONS (*continued*).

(III.) $y = \log_e x.$

$$y + \Delta y = \log_e(x + \Delta x) = \log_e x\left(1 + \frac{\Delta x}{x}\right)$$

$$= \log_e x + \log_e\left(1 + \frac{\Delta x}{x}\right),$$

since the logarithm of the product of two quantities is equal to the sum of the logarithm of the quantities.

$$\therefore \Delta y = \log_e\left(1 + \frac{\Delta x}{x}\right) = \frac{\Delta x}{x} - \tfrac{1}{2}\left(\frac{\Delta x}{x}\right)^2 + \tfrac{1}{3}\left(\frac{\Delta x}{x}\right)^3 - \ldots +.$$

Diminishing Δx indefinitely, and neglecting terms involving the second and higher powers of Δx, we obtain

$$dy = \frac{dx}{x},$$

$$\frac{dy}{dx} = \frac{1}{x}.$$

It can easily be proved by the student that if

$$y = a \log_e x,$$

$$\frac{dy}{dx} = \frac{a}{x}.$$

Further, since $\log_b x = \frac{1}{\log_e b} . \log_e x = \log_b e \, . \log_e x,$

if $y = A \log_b x,$

$$\frac{dy}{dx} = \frac{A}{\log_e b} \cdot \frac{1}{x} = A \log_b e \cdot \frac{1}{x}.$$

(IV.) $y = a \sin bx,$

$$y + \Delta y = a \sin b(x + \Delta x),$$

$$= a(\sin bx \cos(b\Delta x) + \cos bx \sin(b\Delta x)).$$

When Δx is made infinitely small (Δx being then written dx),

$$\cos(bdx) = 1,$$

$$\sin(bdx) = bdx,$$

$$\therefore y + dy = a(\sin bx \times 1 + \cos bx \times bdx),$$

$$\therefore \quad dy = ab \cos bx \, . dx.$$

$$\frac{dy}{dx} = ab \cos bx.$$

(V.) $y = a \cos bx$

$$y + \Delta y = a \cos b(x + \Delta x)$$

$$= a(\cos bx \cos b\Delta x - \sin bx \sin b\Delta x).$$

When Δx is made infinitely small (Δx being then written dx).

$$y + dy = a \cos bx - a \sin bx \times bdx$$

$$dy = -ab \sin bx \, . \, dx$$

$$\frac{dy}{dx} = -ab \sin bx.$$

(VI.) $y = a \tan bx$

$$y + \Delta y = a \tan b(x + \Delta x)$$

$$= a\frac{\sin b(x + \Delta x)}{\cos b(x + \Delta x)}$$

$$= a\frac{\sin bx \cos b\Delta x + \cos bx \sin b\Delta x}{\cos bx \cos b\Delta x - \sin bx \sin b\Delta x}.$$

When Δx is made infinitely small (Δx being then written dx),

$$dy = a\left\{\frac{(\sin bx \times 1) + (\cos bx \times bdx)}{(\cos bx \times 1) - (\sin bx \times bdx)} - \frac{\sin bx}{\cos bx}\right\}$$

$$= a\frac{\sin bx \cos bx + \cos^2 bx \times bdx - \sin bx \cos bx + \sin^2 bx \times bdx}{\cos bx(\cos bx - \sin bx \, . \times bdx)}$$

$$= a\frac{(\cos^2 bx + \sin^2 bx)\, bdx}{\cos^2 bx - \cos bx \sin bx \times bdx}.$$

Further, $\cos^2 bx + \sin^2 bx = 1.$

Also, the second term in the denominator of (7), being multiplied by dx, may be neglected in comparison with the first term. Hence

$$dy = ab\frac{dx}{\cos^2 bx}$$

$$\frac{dy}{dx} = \frac{ab}{\cos^2 bx}.$$

(VII.) $y = a \cot bx$

By reasoning essentially similar to that employed in (VI.) it may be shewn that—

$$dy = -\frac{abdx}{\sin^2 bx},$$

$$\frac{dy}{dx} = -\frac{abdx}{\sin^2 bx}.$$

The results obtained above may be conveniently collected for future reference.

(I.) If $\quad y = ax^n,$

then $\quad dy = nax^{n-1}dx$

$$\frac{dy}{dx} = nax^{n-1}.$$

(II.) If $\quad y = a^{bx},$

then $\quad dy = b \log_e a \, . \, a^{bx}dx$

$$\frac{dy}{dx} = b \log_e a \, . \, a^{bx}.$$

In particular, when

$$y = Ae^{bx}$$

$$dy = Abe^{bx}dx$$

$$\frac{dy}{dx} = Abe^{bx}.$$

(III.) If $\quad y = A \log_b x,$

then $\quad dy = \frac{A}{\log_e b}\frac{dx}{x} = A \log_b e \frac{dx}{x}$

$$\frac{dy}{dx} = A \log_b e \cdot \frac{1}{x}.$$

In particular, when

$$y = A \log_e x$$

$$dy = \frac{A}{x}dx$$

$$\frac{dy}{dx} = \frac{A}{x}.$$

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$$\frac{dy}{dx} = ab \cos bx.$$

(V.) If $y = a \cos bx$,

then $dy = -ab \sin bx \, . \, dx$

$$\frac{dy}{dx} = -ab \sin bx.$$

(VI.) If $y = a \tan bx$,

then $$dy = \frac{ab}{\cos^2 bx} dx$$

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(VII.) If $y = a \cot bx$,

then $$dy = \frac{-ab}{\sin^2 bx} dx$$

$$\frac{dy}{dx} = \frac{-ab}{\sin^2 bx}.$$

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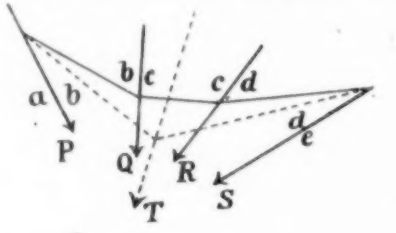
If the forces are all in one plane but do not pass through one point, the general conditions of equilibrium are:—

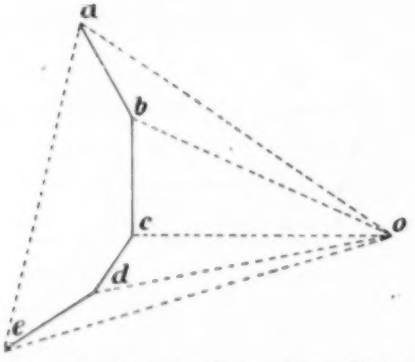
(*a*) The sum of the components of all the forces in any two directions in the plane at right angles should equal zero.

$\therefore \Sigma(X) = 0$; $\Sigma(Y) = 0$.

(*b*) The sum of the moments of all the forces about any point in the plane shall vanish.

The resultant of any number of forces in one plane but which do not pass through one point, can be obtained graphically as follows:—





Let P, Q, R, S be four known forces. A convenient method of lettering, to denote each force, is to place two letters one on each side of the line. Draw the force polygon *abcde*, making *ab* equal in magnitude and parallel in direction to the force P, and *bc* equal and parallel to Q; *cd* and *de* equal and parallel to R and S respectively.

Then the resultant is given in direction and magnitude, but *not* in position by the closing line *ae* of the force polygon.

To obtain the position of the resultant, select any convenient point *o*, called the pole, and join *abcde* to *o*.

Next draw a line parallel to *bo* across the lines of action of P and Q as shown, and from its point of intersection with the line of action of the force Q draw a line parallel to *co* and *do*.

Finally, draw lines parallel to *ao* and *eo* respectively, intersecting in *r*, then *r* is a point in the line of action of the resultant T, and as its magnitude is known it can be placed in position. The force, equal in magnitude but opposite in direction, will be the equilibriant, and the five forces so determined will form a system of forces which, if acting simultaneously on a rigid body, will produce equilibrium.

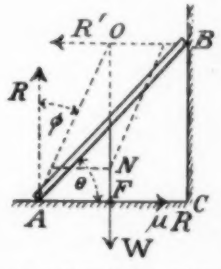
The polygon, used to determine the *magnitude* and direction of the resultant is called a *force polygon*. That drawn in the spaces between the lines of action of the given forces and which determines the *position* of the resultant is called a *funicular polygon*. The funicular polygon, or link polygon as it is sometimes called, is so very important in graphical solutions that we hope to refer to it at greater length at an early date.

The general conditions of equilibrium for any system of forces in one plane are as follows:—

Graphic conditions.—*The force polygon is a closed figure*, and *the funicular polygon* has its *initial and final sides coincident.*

As the projection of any closed figure on any line is zero, the first condition that the force polygon is a closed figure is equivalent to the *analytical* condition that *the sum of the components of all the forces in any two directions in the plane at right angles to each other shall be zero*, or $\Sigma(X) = 0$; $\Sigma(Y) = 0$. The remaining analytical condition is that the sum of the moments of all the forces about any point in the plane shall be zero, or $\Sigma(Yx - Xy) = 0$.

Many examples could be given of the graphic solution of questions, and graphic methods should be applied wherever possible. In next month's notes one or two typical cases will be given.



Consider the case of a uniform ladder, of length l and weight W, resting on a rough horizontal surface at A and against a smooth vertical wall BC. As the distance of the end A of the ladder from the wall is increased, the direction of the reaction at A becomes inclined to the normal AR, and the frictional force between the end A and the surface in contact also increases; when the inclination of the reaction to the normal becomes equal to the angle of friction or angle of repose for the two surfaces in contact, then the maximum amount of friction μR is exerted, and for any further motion slipping at A will occur.

Hence, if the figure be drawn to scale, W and l being given, the three forces keeping equilibrium are the reactions at A and B and the weight W; these must all pass through one point O, and setting off ON = W, the parallelogram can be completed, and the reactions and the angle θ can be obtained.

Resolving horizontally $R_1 = \mu R$. (1)

Resolving vertically $R = W$. (2)

Taking moments about any point A (this is a convenient point because two of the forces pass through the point and have no moment about it), we have

$$R_1 \times BC = W \times AF,$$

but $$AF = \frac{l}{2} \cos\theta;$$

also $$BC = l \sin\theta;$$

$$\therefore R_1 l \sin\theta = W \times \frac{l}{2} \cos\theta;$$

but $R = W$, from (2),

and $\mu R = R_1$, from (1);

$$\therefore \mu R \sin\theta = \frac{R}{2} \cos\theta;$$

$$\therefore \mu \sin\theta = \frac{\cos\theta}{2},$$

$$\text{or } \tan\theta = \frac{1}{2\mu}. \quad (4)$$

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Eq. (4) may be used to determine the limiting angle θ when the angle μ is given, or, given the limiting angle, the value of μ can be obtained.

Ex. (1). If the inclination of the ladder be 60° and it begins to slide when a man has ascended so that the centre of gravity of the man and the ladder is half-way up, then the coefficient of friction between the foot of the ladder and the pavement, from (4), is $\frac{1}{4}\sqrt{3}$.

Assuming both the horizontal plane and the vertical wall to be rough, the coefficient of friction being μ and μ' respectively, then, as before, resolving vertically and horizontally and taking moments about a point, we obtain

$$\tan\theta = \frac{1 - \mu\mu'}{2\mu}. \quad (5)$$

Thus if $\mu = \frac{\sqrt{3}}{6}$ and $\mu' = \frac{\sqrt{3}}{2}$,

$$\tan\theta = \frac{1 - \frac{\sqrt{3}}{6} \times \frac{\sqrt{3}}{2}}{2 \times \frac{\sqrt{3}}{6}} = \frac{3\sqrt{3}}{4} = 1{\cdot}298.$$

From tables the angle is found to be 52° 24′.

It will be noticed that (4) can be obtained from (5) by writing $\mu' = 0$, corresponding to a smooth wall.

Also if in addition $\mu = 0$, then $\tan\theta = 0$, or equilibrium is impossible.

Ex. (2). A uniform beam rests against a smooth wall, the lower end resting on a rough horizontal plane. If the amount of friction required to prevent sliding is one-half the weight of the beam, find the inclination of the beam. Ans. 45°.

Ex. (3). Find the conditions of equilibrium of a particle acted on by any number of forces in one plane.

A body weighing 10 lb. rests upon a plane inclined to the horizontal at an angle of 45°, the angle of friction being 30° under the action of the least force which will prevent it from sliding down the plane; find this force in magnitude and direction. (N.B.—A graphical solution will be accepted.) (1898.)

Ex. (4).—A uniform rod rests in limiting equilibrium against a smooth fixed point C, with one end on a rough horizontal plane; given the height of C above the plane, and the inclination of the rod to the horizon, find the length of the rod.

For a given coefficient of friction what is the *steepest* inclination of the rod? (1896.)

Let l denote the length of the rod, h the height of the fixed smooth θ the inclination of the rod to the horizon, μ the coefficient of friction between the rod and the rough horizontal plane.

Then $$l = \frac{4\mu h}{\sin 2\theta\,(\sin\theta + \mu\cos\theta)}$$

Also $$\cos\theta\sin^2\theta + \mu\sin\theta\cos^2\theta = \frac{2h}{l}\mu.$$

Ex. (4). Investigate the equations which express the conditions that are necessary and sufficient for the equilibrium of any number of forces acting in one plane at a point.

Four forces keep a particle (O) at rest: they follow each other in order, viz., P, P_1, Q, Q_1. If the directions of the first pair (P and P_1) contain a right angle, and also the directions of the second pair (Q and Q_1), show that the cosine of the angle QOP_1 equals $(PQ_1 - P_1Q) \div (P^2 + P_1^2)$. (1880.)

Ex. (6). The conditions of equilibrium of any number of forces acting in one plane on a rigid body being given in the usual form, viz: $\Sigma(X) = 0$, $\Sigma(Y) = 0$, $\Sigma(Xy - Yx) = 0$, state the meaning of each of these equations

Supposing, for distinctness, that the axes of reference are horizontal and vertical, is it necessary for the equilibrium of the body that the vertical components of the forces should be in equilibrium, and also that the horizontal components of the forces should be in equilibrium?

Give a reason for your answer. (1881.)

Ex. (7). Show how to find the resultant of any number of forces acting in a plane at a point.

Draw an equilateral triangle ABC and draw AD at right angles to BC; a force P acts from A to B; a force 2P from A to C; and a force 2P from D to A; find the resultant of the three forces. (1882.) Ans. $\sqrt{7}$P.

Ex. (8). State and prove the rule (called the Polygon of Forces) for finding the resultant of any number of forces acting at a point.

Draw a square ABCD, and a diagonal AC; let forces of 40, 25, and 20 units act at A, from D to A, A to C, and A to B, respectively; find their resultant by the polygon of forces. (1883.) Ans. 43·8.

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Stage 2.

Algebra.

Quadratic Equations:—

Hamblin Smith's 'Elementary Algebra.'—Read Arts. 235-248. An attempt is made to treat different cases in different articles. Ignore this, but observe that the *method* is the same in all cases.

Work the following:—Exs. lxxxvi., Nos. 1, 7, 8; Exs. lxxvii., Nos. 1, 7, 10; Exs. lxxxviii., Nos. 9, 10; Exs. xcii., Nos. 4, 10, 22, 33, 39, 42.

Hall and Knight's 'Elementary Algebra.'—Read Chap. xxv., particularly Arts. 194, 195, 201, 202.

Work the following: Exs. xxv. *a*, Nos. 1, 9, 19, 22; Exs. xxv. *b*, Nos. 9, 22, 24, 27; Exs. xxv. *c*, Nos. 14, 22, 27, 32, 39.

C. Smith's 'Elementary Algebra.'—Read Arts. 139, 141, 143, 148.

Work the following:—Exs. xliii., Nos. 1, 10, 16, 25, 49; Exs. xliv., Nos. 2, 9, 29, 39; Exs. xlv., Nos. 6, 14, 21, 32, 44.

Miscellaneous Examples:—

1. Simplify $\frac{\{(a+b)(a+b+c)+c^2\}\{(a+b)^2-c^2\}}{\{(a+b)^2-c^2\}(a+b+c)}$. Ans. 1.

2. Find the factors of $x^2y^2z^2 - x^2z - y^2z + 1$;
$4(ab-cd)^2 - (a^2+b^2-c^2-d^2)^2$; x^4+x^2+1.
Ans. $(x^2z-1)(y^2z-1)$; $(a+b+c+d)(a-b+c-d)$
$(a+b-c-d)(-a+b+c-d)$; $(x^2+x+1)(x^2-x+1)$.

3. Solve the equation—
$$(3a^2+b^2)(x^2-x+1) = 3b^2+a^2)(x^2+x+1).$$
Ans. $\frac{a+b}{a-b}, \frac{a-b}{a+b}$

4. The sum of the digits of a certain number which is less than a thousand is 23. Show that if the number is multiplied by 2, the sum of the digits of the product will be 19.

Trigonometry.

1. It is necessary that you should know the definitions of the trigonometrical ratios of an angle as thoroughly as you know your alphabet; little progress can be made until this degree of familiarity is attained.

2. Realize that when any two sides of a right-angled triangle are known, we can find the third side; hence, if we know *one* trigonometrical ratio of a triangle we can determine all the others.

3. If a triangle ABC is right-angled at C, then by definition
$$\sin A = \frac{BC}{AB} \text{ and } \cos A = \frac{AC}{AB};$$
therefore $BC = AB \cdot \sin A$ and $AC = AB\cos A$.

But it is very important that you should practise writing down the last two equations without previously writing the first pair. Please attend to this.

4. The trigonometrical ratios of an angle being defined by means of the sides of a right-angled triangle, since there is a well-known relation between these sides, namely, $AB^2 = AC^2 + BC^2$, where C is the right angle, you should at once learn that there are similar relations between the trigonometrical ratios. Thus we have the most important elementary relations
$$\sin^2A + \cos^2A = 1$$
$$\sec^2A = 1 + \tan^2A$$
$$\operatorname{cosec}^2A = 1 + \cot^2A.$$
Also you may readily prove that $\frac{\sin A}{\cos A} = \tan A$.

Hamblin Smith's 'Trigonometry.'—Read Chap. V.; Arts. 62, 63, 64, 82–90.

Work the following: Exs. xiii., Nos. 1, 2; Exs. xv., Nos. 1, 2, 4, 6, 15; Exs. xvi., 1 to 10.

Loney's 'Elementary Trigonometry.'—Read Arts. 46–52; 27, 41–45.

Work the following: Exs. v., Nos. 7, 9, 11, 12, 16; Exs. viii., Nos. 1, 2, 3, 5.

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Hall and Knight's 'Elementary Trigonometry.'—Read Arts. 72–76; 15, 16; 22–29; 33; 48, 49.

Work the following: Exs. viii. *a*, Nos. 2, 9; Exs. ii., Nos. 1, 5, 12; Exs iii. *a*, 1–10; Exs. vi. *a*, 1, 2, 6, 11.

Lock's Trigonometry.—Read Chaps. vii., viii., and ix.; Arts. 97–101. *Work* Exs. xv. 1–10; Exs. xiv. 2, 4, 7; Exs xxv. 1, 6, 8, 9; Exs. xxvi. 1, 3, 4, 11; Exs. xxvii. 1, 7.

Miscellaneous Examples :—

1. If $\sec a = \frac{13}{5}$, find the value of $\frac{2\sin a - 3\cos a}{4\sin a - 9\cos a}$.

Ans. $\frac{1}{3}$.

2. If $25 \sin A = 7$, find tan A and sec A.

Ans. $\frac{7}{24}, \frac{25}{24}$.

3. Draw a triangle ABC, right-angled at C. Take AB = 20, and write down the values of AC and BC, when

(1) A = 20°; (2) A = 35° 12′; (3) B = 60°.

[N.B. You will require a book of mathematical tables.]

4. Which of the following statements are possible, and which impossible?

(1) $4 \cos \theta = 12$; (2) $2 \sin \theta = 1{\cdot}5$; (3) $2 \operatorname{cosec} \theta = 1$; (4) $7 \tan \theta = 20$.

5. In a triangle ABC right-angled at C, prove that

$$\tan A + \tan B = \frac{c^2}{ab}.$$

6. How many radians are there in 360°, 150°, and 1½ right-angles?

Ans. 6·29; 2·618; $\frac{3\pi}{4}$.

Stage 3.

Algebra.

Indices.—Read one of the text-books with the object of understanding what meanings are given to such expressions as—

$$a^{-n}, a^{\frac{m}{n}}, a^{\frac{1}{n}}, a^0, \text{ etc.}$$

Hall and Knight's 'Elementary Algebra,' Chap. xxx. Consider carefully Art. 236. *Work* Exs. xxx*b*. Nos. 16, 27, 34; Exs. xxx*d*. Nos. 29, 32.

C. Smith's 'Treatise on Algebra,' Arts. 160–168. *Work* Exs. xvii. Nos. 2, 3, 4, 14, 17.

Todhunter and Loney's 'Algebra.' Read Chap. xxix., carefully considering Art. 300. *Work* Exs. lxxx., Nos. 18, 20, 29, 34.

'Intermediate Algebra,' Briggs and Bryan. Read Chap. i. *Work* Exs. i. Nos. 4, 7, 11, 18, 20.

Observe that we may *realise* that a^0 is *unity*, by taking any number, say 4, extracting its square root, and the square root of that, then taking its square root, repeating this to any desired extent. It will be *seen* that the results get nearer and nearer to 1, that is—

$4^{\frac{1}{2}} \cdot \frac{1}{2} \cdot \frac{1}{2} \cdot \frac{1}{2} \quad \ldots \ldots = 1 +$ a quantity which becomes less and less.

Miscellaneous examples :—

1. Find x if $2^{x^2} : 2^{2x} :: 8 : 1$. Ans. 3 or −1.

2. If α and β are the roots of $ax^2 + 2bx + c = 0$, form the equations whose roots are (1) α^2 and β^2, (2) $\alpha + \beta$ and $\frac{1}{\alpha} + \frac{1}{\beta}$.

Ans. (1) $a^2x^2 - (4b^2 - 2ac)x + c^2 = 0$;
(2) $acx^2 + 2bx(a + c) + 4b^2 = 0$.

3. Simplify—

$$[\{(a^{-m})^{-n}\}^{-p}] \div [\{(a^{2m})^{-3p}\}^{2n}]. \quad \text{Ans. } a^{11mnp}$$

4. If $\frac{b^2 - ac}{a + c - 2b} = \frac{c^2 - ld}{b + a - 2c}$, then each $= \frac{bc - ad}{a + d - b - c}$, b and c being unequal.

5. If $xy = ab(a + b)$, and $x^2 - xy + y^2 = a^2 + b^2$, prove that

$$\left(\frac{x}{a} - \frac{y}{b}\right)\left(\frac{x}{b} - \frac{y}{a}\right) = 0.$$

Trigonometry.

Geometrical proofs of the formulæ for the trigonometrical ratios of the sum and difference of two angles should be studied. These are found in most text-books.

Hall and Knight's 'Trigonometry,' Chap. xxii., should be carefully read.

The student should regularly test his knowledge of the formulæ just referred to, and those immediately formed from them. For example :—

1. Given the *sum* or *difference* of *two sines* or *two cosines*, express it as the product of a *sine* and a *cosine*, or of two *sines*, or of two *cosines*.

2. Given a *product* of a *sine* and a *cosine*, or two *sines* or two *cosines*, express it as the *sum* or *difference* of two *sines* or two *cosines*, as the case may be.

3. Given the cosine or sine of *any* angle, express it in terms of the sine or cosine of the *half angle*, or the *squares* of these.

4. Given the *square* of the sine or cosine of *any* angle, express it in terms of the cosine of the *double angle*.

A thorough knowledge of these is indispensable.

Miscellaneous Examples :—

1. Prove that $\cos(A + B)\cos B + \sin(A + B)\sin B = \cos A$.
2. Prove that $1 + \tan 2\theta \cdot \tan \theta = \sec 2\theta$.
3. Find the expansion of $\cos(A + B + C)$.
4. Find tan A when $\cos 2A = \cdot 96$. Ans. $\frac{1}{7}$.
5. Show that $\frac{\sin 7\alpha}{\sin \alpha} = 1 + 2\cos 2\alpha + 2\cos 4\alpha + 2\cos 6\alpha$.

Hint.—When there is a series of sines *or* cosines, in which the angles are in Arith. Prog. and the coefficients are equal, to find their sum multiply the series by *twice the sine of half the common difference* (and afterwards divide by this), split up the products so formed, and simplify.

6. Two persons who are 500 yards apart observe the bearing and angular elevation of a balloon at the same instant. One finds the elevation 60° and the bearing S.W., the other finds the elevation 45° and the bearing W. Find the height of the balloon.

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HEAT,

WITH SPECIAL REFERENCE TO ELEMENTARY THERMODYNAMICS.

BY EDWIN EDSER, A.R.C.S., F.PH.S.

Coefficient of Elasticity of a Gas, under Conditions of Constant Temperature.

No resistance is offered by a gas to a mere change of shape in the containing vessel; on the other hand, when the volume of a gas is altered a force of restitution is called into play.

Definition.—The coefficient of elasticity of a gas, under any prescribed conditions, is defined as the ratio of the increase of pressure due to a small alteration in the volume of the gas, divided by the alteration in volume, the initial volume of the gas being supposed equal to unity (one cubic centimetre).

Thus the coefficient of elasticity of a gas may be represented by

Increment of Pressure (measured in dynes per sq. cm.)
÷ *Decrease in volume of* 1 *cc. of the gas, under above increase of pressure.*

Let a quantity of gas at a temperature T, when subjected to a pressure p, occupy a volume of v ccs. Then

$$pv = RT. \quad \ldots \quad (3).$$

Now let the pressure increase to $p + dp$, whilst the volume becomes $v - dv$. Then

$(p + dp)(v - dv) = pv$, from (3), since T remains constant.

Hence, multiplying up

$$pv - pdv + vdp - dp.\,dv = pv.$$
$$\therefore pdv - vdp + dp.\,dv. = 0 \quad \ldots \quad (4).$$

Here the product of $dp.$ and dv, both of which are small quantities, will be very small in comparison with either of the other terms, on the left-hand side of (4), each of which consists of the product of a small by a large quantity. Neglectingthe product $dp \times dv$,

$$pdv - vdp = 0, \quad \ldots \quad (5).$$

But dp represents the increase of pressure corresponding to a decrease of volume dv. Further, the decrease which would have been experienced by unit volume is represented by $\frac{dv}{v}$. Hence the elasticity of the gas, under isothermal conditions, is given by

$$\frac{dp}{\frac{dv}{v}} = \frac{vdp}{dv} = p \text{ by (5)}.$$

It will be shown later that the velocity of sound in a gas is given by the expression

$$\text{velocity of sound} = \sqrt{\frac{\text{Elasticity}}{\text{Density}}}.$$

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The velocity of sound, obtained on the supposition that the compressions and expansions take place under isothermal conditions, was first obtained by Newton. It is given by

$$\sqrt{\frac{p}{\text{Density}}}.$$

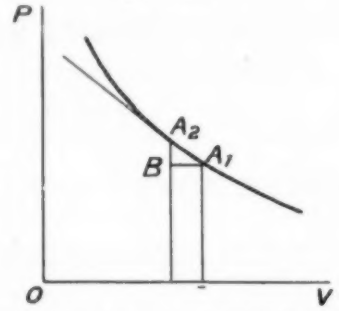
This was found to give a value much too low for the velocity of sound; as a consequence we are not justified in assuming isothermal conditions. Indeed, the compressions and expansions constituting a train of sound waves take place far too quickly for heat to be supplied or abstracted as required to maintain isothermal conditions. This subject will be returned to later.

Exercise.—Show that the velocity of sound in a gas calculated in the above manner is independent of the pressure.

(If the pressure is doubled, so will be the density, so that the value of (5) remains constant.)

Slope of an Isothermal at any point. Let A_1, A_2 (Fig. 1), be two points very close to each other on an isothermal curve, the volume, v, at A_1 being connected with the pressure p and the absolute temperature T of the gas by the equation

$$pv = RT.$$



The volume corresponding to A_2 will be smaller than that corresponding to A_1, by a quantity dv (say). It is obvious that $dv = A_1B$. The corresponding pressure $p + dp$ is determined from

$$(p + dp)(v - dv) = RT.$$
$$\therefore pv - pdv + vdp - dpdv = RT.$$
$$\therefore -pdv + vdp = 0,$$

neglecting $dp \cdot dv$.

$$\therefore \frac{dp}{dv} = \frac{p}{v} = \frac{RT}{v^2} = \frac{p^2}{RT}.$$

It can easily be seen that $ap = BA_2$ (Fig. 1).

But if the points A_1, A_2, are taken very near to each other, the straight line passing through both of these points will be a tangent to the curve. Further, the angle which this tangent makes with the axis of v is equal to $\angle A_2A_1B$. Call this angle θ. Then

$$\tan\theta = \frac{BA_2}{A_1B} = \frac{dp}{dv} = \frac{p}{v} = \frac{RT}{v^2} = \frac{p^2}{RT}.$$

Thus the tangent of the angle of *slope* of the isothermal is determined either in terms of p or v, or both p and v.

If a curve, given by the equation

$$pv^n = K,$$

were in question, the slope could be determined in a similar manner.

(The student is advised to draw a diagram illustrating the process here followed.)

$$(p + dp)(v - dv)^n = K.$$
$$(p + dp)(v^n - nv^{n-1}dv + \frac{n(n-1)}{1 \cdot 2}v^{n-2}(dv)^2 + \dots) = K,$$

expanding by the binomial theorem. Further, if dv is small, we may neglect products of dv and dp, and powers of dv higher than the first. Hence,

$$(p + dp)(v^n + nv^{n-1}dv) = K,$$
$$pv^n - npv^{n-1}dv + v^n dp = K = pv^n.$$
$$\therefore \tan\theta_1 = \frac{dp}{dv} = \frac{np}{v}.$$

Hence the slope of the curve

$$pv^n = K$$

is greater than that of the curve

$$pv = K,$$

for points having the same values of p and v. Moreover,

$$\frac{\tan\theta_1}{\tan\theta} = n.$$

(*To be continued.*)

ELECTRICITY AND MAGNETISM.

BY EDWIN EDSER, A.R.C.S., F.PH.S.

PART I. OF THE HONOURS STAGE.

(*Continued from page 234.*)

We have now arrived at the result that as the coil is revolved about a diameter in its plane, there will be a variable E.M.F. generated; and further, that the numeral value of this E.M.F. will be given by the equation

$$E = 2\pi nFa \cdot \sin(2\pi nt),$$

where the symbols employed have the following significations:—

E = instantaneous value of the induced E.M.F.
F = the vertical component of the earth's field.
a = the area enclosed by the coil.
n = the number of complete revolutions made by the coil in one second,
$= \frac{1}{T}$ where T is the time occupied by one complete revolution of the coil.

We have further seen that this instantaneous value of the E.M.F. can be obtained graphically by supposing a radius, equal in length to the maximum value of the induced E.M.F. ($2\pi nFa$), to revolve uniformly n times per second; and drawing a perpendicular from the instantaneous position of the moving end of this radius on to a straight line passing through the centre of the coil, and at right-angles to the datum line from which the moving radius started at the time $t = 0$. Then the distance OE from the centre along this vertical line to the point cut by this perpendicular will give the E.M.F. at the instant under consideration.

It might at first sight now appear easy to determine the current at any instant, using the relation, generally spoken of as Ohm's Law,

$$C = \frac{E}{R},$$

where R is the resistance of the coil. But if the coil is revolving quickly the problem is really much more complicated. Directly a current begins to flow, lines of force must be generated by it; hence we introduce new lines of force into the circuit as the current increases, with the result that an opposing E.M.F. is generated. Here, as previously, the value of this E.M.F. will be given by the rate of alteration of the field produced.

Let us assume that the current at any instant will be given by

$$c = C\sin(2\pi nt - \alpha).$$

Here C is the maximum value of the current, which we wish to determine, and the angle α is termed the *angle of lag* of the current. The value of α will also be determined. For the present, we may simply note that the above equation assumes that the current will not have its maximum value at the times when the E.M.F. is at a maximum.

Let L = the total number of lines of force due to unit current flowing through the coil. L is termed the *coefficient of self-induction of the coil*. It will evidently depend on the shape of the coil, and the number of turns of wire. Then, corresponding to a current c, there will evidently be cL lines of force passing through the coil. Hence the *instantaneous value* N_1 of the secondary induction through the coil due to its own current is given by

$$N_1 = LC\sin(2\pi nt - \alpha).$$

This is the value at time t. At time $t + dt$ the value will be given by

$$N_1 + dN_1 = LC\sin(2\pi n(t + dt) - \alpha)$$
$$= LC\{\sin(2\pi nt - \alpha)\cos 2\pi ndt + \cos(2\pi nt - \alpha)\sin 2\pi ndt\}$$
$$= LC\{\sin(2\pi nt - \alpha) \times 1 + \cos(2\pi nt - \alpha) \times 2\pi ndt\}$$

when d is negligibly small.

$$\therefore dN_1 = +2\pi n\,LC\cos(2\pi nt - \alpha) \cdot dt$$
$$-\frac{dN_1}{dt} = -2\pi n\,LC\cos(2\pi nt - \alpha). \quad \dots \quad (1)$$

From the explanations previously given, it can readily be seen that (1) gives the instantaneous value of the *back* E.M.F. *of self-induction*.

Hence there are two components of E.M.F. necessary to drive the current.

1. $e_1 = CR\sin(2\pi nt - \alpha)$. This is the E.M.F. necessary to overcome the ordinary resistance R of the coil.

2. $e_2 = 2\pi n\,LC\cos(2\pi nt - \alpha)$, which is the E.M.F. necessary to overcome the back E.M.F. of self-induction.

Let E_0 be the maximum value of the E.M.F. induced by the rotation of the coil in the earth's field, supposing that no current is allowed to flow. ($E_0 = 2\pi nFa$, as previously given.) Then the E.M.F. at the instant when the current is c will be given by

$$e = E_0\sin(2\pi nt).$$

Hence, since this E.M.F. must be equal to the sum of the two already determined, we have

$$e = e_1 + e_2,$$
$$E_0\sin(2\pi nt - \alpha) = C(R\sin(2\pi nt - \alpha) + 2\pi nL\cos(2\pi nt - \alpha) \quad (2)$$

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Let $R = A\cos\phi$ . . . . . (a)

$2\pi nL = A\sin\phi$ . . . . . (b)

$$\therefore \tan\phi = \frac{2\pi nL}{R} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (3)$$

Since $\sin^2\phi + \cos^2\phi = 1$, we also have

$$R^2 + (2\pi nL)^2 = A^2 \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (4)$$

Hence (2) can be written, when we substitute the value of A given by (4) in (a) and (b) above, and then substitute the values so obtained for R and $2\pi nL$ in (2),

$$E_0 \sin(2\pi nt) = C\sqrt{R^2 + (2\pi nL)^2}\,(\sin(2\pi nt - a)\cos\phi + \cos(2\pi nt - a)\sin\phi)$$

$$= C\sqrt{R^2 + (2\pi nL)^2}\,(\sin(2\pi nt - a + \phi)),$$

remembering the trigonometrical relation

$$\sin(A + B) = \sin A\cos B + \cos A\sin B.$$

Re-writing our result, we have

$$E_0 \sin(2\pi nt) = C\sqrt{R^2 + (2\pi nL)^2}\sin(2\pi nt - a + \phi).$$

Hence

$$E_0 = C\sqrt{R^2 + (2\pi nL)^2} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (5)$$

and

$$C = \frac{E_0}{\sqrt{R^2 + (2\pi nL)^2}}.$$

Further,

$$\sin 2\pi nt = \sin(2\pi nt - a + \phi),$$

$$\therefore \phi = a \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (6)$$

All that now remains is to interpret our results.

1. From (5) we conclude that if, instead of R, the resistance to a steady current, we take the expression $\sqrt{R^2 + (2\pi nL)^2}$ as the effective resistance R_1 to the alternating or oscillatory current produced in the coil, we obtain for the maximum current C the value

$$C = \frac{E_0}{R_1} = \frac{E_0}{\sqrt{R^2 + (2\pi nL)^2}}.$$

This effective resistance to an oscillatory current is called the *Impedance* of the circuit. It is numerically equal to the hypotenuse of a right-angled triangle, whose base = R, the perpendicular being equal to $2\pi nL$. Notice that the Impedance varies with n, the number of alternations per second and L, the coefficient of induction of the coil. Thus, if our coil rotates rapidly in the earth's field, although its resistance to a steady current may be very small, yet no appreciable current might be produced. This fact is often made use of where alternating currents are employed for lighting purposes, a *choking coil*, as it is termed (*i.e.* a coil possessing a large coefficient of self-induction), being sometimes used to diminish a current without any great amount of energy being absorbed.

The effect of self-induction can be very easily illustrated when an alternating current can be produced or obtained. Let an ordinary glow lamp be connected with the supply mains of an alternating current station, a coil of a good many turns of wire being placed in series with it. The coefficient of self-induction of the coil will probably not be sufficiently great to materially decrease the brightness of the lamp. On the other hand, if a piece of soft iron be introduced into the coil, the number of lines of force generated by a given current will be increased many hundred times; *i.e.* the coefficient of self-induction of the coil will be greatly increased. Hence the Impedance or effective resistance of the circuit will be increased, and the resulting diminution in the current strength will cause the lamp to become much duller, or perhaps almost non-luminous.

2. The angle a is determined from the equations (6) and (2).

$$a = \phi,$$

$$\tan\phi = \frac{2\pi nL}{R}.$$

This means that if the current strength is represented by the resolved component of a revolving radius, in the manner previously used for E, then this radius will lag behind the radius which gives E, by the above angle a.

Hence the maximum value of the induced current will occur later than the maximum value of the induced E.M.F. Indeed, if R is very small, and nL correspondingly great,

$$\tan a \propto a, \; a = \frac{\pi}{2}.$$

Hence in this case, when the E.M.F. has its maximum value, there will be no current flowing, whilst the maximum current strength will occur at a period when there is no induced E.M.F.

This question has been answered at some length, both on account of the intrinsic interest of the problem, and because it is a question likely to recur. The principles explained above are, as can readily be understood, of vital importance in connection with alternating current supply, and as there is a growing tendency in the S. and A. questions to lean toward the scientific side of technical problems, students cannot do better than to carefully follow the above train of reasoning, with the certainty that time thus spent is most profitably employed.

SCIENCE NOTES.

A New Food Material.—A valuable food material has lately been extracted from fœnugreek seeds. It is free from starch and highly nitrogenous. The seeds are ground to powder, deprived of essential oil by treatment with ether or some other solvent, and then extracted with ethyl or methyl alcohol to remove the bitter principle and resinous matter.

***

Dust and Bacteria.—Neisser has lately instituted some interesting researches into the dispersing of pathogenic organisms by means of minute currents of air below that of a sensible current. He finds that the bacilli of diphtheria, typhoid, plague, cholera, and pneumonia are incapable of being carried as atmospheric dust. *Staphylococcus pyogenes aureus* and B. *pyogenes*, B. *anthracis*, B. *tuberculosis*, are, however, capable of being so conveyed.

***

Iron in Plants.—Stocklasa some time ago demonstrated that iron is not present in chloro-lecithin. He now finds that this metal exists in plants in the form of an organic compound which possesses similar properties and constituents in the haematogen of animals as isolated by Bunge. It is chiefly stored up originally in the embryo or endosperm. During germination it is drawn upon to form the nucleus of the cells of the young organs. After this the plant procures it from its environment, and dies if it is deprived of the metal. No vegetable haematogen can be detected in plants grown in a medium free from iron. The presence of iron in the nutritive source of food is as essential to fungi which are free from chlorophyll as to highly developed plants. Like phosphorus it is an essential constituent of the cellular nucleus.

***

The Artificial Production of Alpine Characters in Plants.—In a recent number of the *Comptes rendus*, M. G. Bonnier gives an account of a series of experiments made at Fontainebleau, from which he concludes that it is possible to produce artificially the special characters of Alpine plants by subjecting them to alternations of temperature similar to those which they experience at high altitudes. He compared cultures of the same species obtained from the same stock:—(1) When kept constantly at a low temperature (4° to 90° C.); (2) when subjected to the normal alternations of temperature in the neighbourhood of Paris; (3) When exposed to a very low temperature at night and to strong isolation during the day. When compared with lots (1) and (2) those of lot (3) were found to exhibit a decrease in stature, the internodes becoming proportionately shorter, the leaves smaller, thicker, and of firmer consistency, with a more rapid production of flowers.

***

The Preparation of Caoutchouc.—*Hevea Brasiliensis*, the tree which produces Para rubber, is now under increasing cultivation in India, Ceylon, Straits Settlement, Zanzibar, Gold Coast and other tropical parts. The most suitable soil and situation for the tree is fairly flat land at about the sea level, with good alluvial soil, preferably jungle land, and not sandy. The land should not be subject to frequent floods or strong winds. Various methods are adopted in different countries for the coagulation of the latex. Heat is the commonest agent employed. The juice in Mexico is heated to boiling; in Brazil and Venezuela it is spread on tiles and exposed to the action of smoke; in West Africa thickening is effected by the direct action of the sun's rays. To bring about coagulation alum is used by the inhabitants of Brazil, salt is used on the Ivory Coast, sulphuric acid in Maranham, the juice of the citron in Madagascar, and vegetable infusions in Peru and Madagascar.

***

Bacteria in Hailstones.—An interesting examination of the bacteria contained in hailstones has been made by F. C. Harrison, of Guelph, Ontario. The stones were washed in mercuric chloride solution (1 in 500) and rinsed several times in sterilised cold water. Then each stone was dropped into a tube of melted nutrient gelatin, the mixture was thoroughly shaken, and plates were made in the usual way. Four days after the plates were coated all the bacteria and a number of moulds were isolated and their cultural characteristics determined. Among the micro-organisms present were *Penicillium glaucum*, *Mucor* species, *Aspergillus* species, B. *fluorescens liquefaciens*, and B. *fluorescens non-liquefaciens*, and a varying form of *Proteus Vulgaris*. Two micro-organisms occurred—a bacillus and a coccus—which seem new. For them Mr. Harrison suggests the names B. *flavus grandinis* and M. *melleus grandinis*. These facts seem to support Bujuid's surmise that hailstones are formed by surface water being carried up by storms and frozen.

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FRENCH AND GERMAN PRIZE COMPETITION.

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All translations should be posted not later than the 8th of the month and addressed:—*Prize Editor*, Office of THE PRACTICAL TEACHER, 33, Paternoster Row, London, E.C. *Other Rules as usual.*

FRENCH COMPETITION.

The prize is awarded to *Eicarg*, the pseudonym of G. Masson, 36, Comiston Drive, Morningside, Edinburgh.

First Class.—Hubertine, Currente calamo, Leswyn Farm, C.E.M., Agricola, Skeers, Forward, Polly, Iolo Morganwg, Agaznog, O Mimosa San, Union Jack, Echo, Hirondelle, Sans Gêne, Isobel (Yeovil), Gwendoline, Nellie, Rus, Helm Crag, Teufelsdröckh, M.O'N., Chemineau, Percy, Carpe diem, Land o'the Mountain, Avondale, Mary Anne, B.M.M., Nortoniensis, Diable rose, Josephine, Spero, Rock Kary, Day dawn, Espérance (Upton), Claremont, Cymru, Kettering, Vita, Bess, Spes, Chrysanthemum, Cleg, Sea, Ignoramus, Trude, Sans espérance, Moorland, Langwell, Crockitweeds, Swansonian, Espérance (Forfar), Crocmore, Madame, Joe, Adest, Ignatius, Brunette, Isobel (Herne Bay), Annette, Pelican, Zox, Enila, Hatfield, Rob Roy, Nemo, Bijou, Insouciant, Semper fidelis, Le sud, Elspeth, Muir Hall, Enthusiast, Middleton, Angela, Dinga, Newton Road, E.S., Wieder, Une élève, Treherbert, Ione, Amor, Sexes, Thundergay, Lawson, Une irlandaise, Rodogune, Käthe, Aimée, Françoise, Meg Merrilies, David, Maida Vale, Dot.

Second Class.—Llewellyn, Clarionette, Des Roches, Margot, Senrac, Godesberg, Anthony, Lamda, Hyacinthe, Gamine, La poupée, Trillo, Expectation, Pip, May, I.E., Augustine, Yhtorod, Indoctus, Kingston, Beginner, Faith, Sursum corda, Scallywag, Biondi, Hopeful, Little Quakeress, Fido, Braxet, Thekla, Morningside, Sandy, Integer, Imogen, Andromaque, Roman, Terry, Shamrock, Soror, Dei donum, Flo fach o Barri, Mayflower, Set, Novice, Jack, Marmion, Primula, Griselda, Veronica, Annie Louise, Heugh, Ibea, Carsluith, Nance, Nil desperandum, The Geisha, Toby, Eager, Gladys, Daisy, Erica, Mary, Floreat Salopia, E.J.C., Keep at it, Méné, Map, Orris, Gowanlea, Cwstennin, Ester B., Glabrio, G—moll, Leamington, Phyllis, Ayacanora, Bruyère, Précepteur, Ko-ko, Sam, Day-dreams, Chester, Frances, Ciriac, Semper vigilans, Scottie, Vive la confrérie.

Third Class.—Excelsior, Cadet, Fleetwood.

Prize Translation.

The inhabitants of this district have plenty of mother-wit, too much vivacity, and the fickleness of a weather-cock. This comes, I think, from the changeableness of their weather, which passes in twenty four h urs from cold to heat, from calm to tempest, from cloudless skies to torrents of rain. It is impossible that these phenomena should not leave their mark upon them, and that their minds should be for long in the same key. They accustom themselves thus, from their earliest days, to answer to every breeze. The head of a Langrois veers round on his shoulders like the weather-cock on the top of a church-steeple; it is never steady in one position, and if it does return to that which it has left, it is not to remain there. With a surprising rapidity in their movements, desires, plans, imaginations, and ideas, their tongue moves but slowly. As for me, I have all the characteristics of my country, only my stay in the capital and my persevering efforts have somewhat improved me. I am constant in my tastes; what has pleased me once pleases me always, because my choice is always the result of conviction; whether I love or hate, I know the reason why.

A Prize of One Guinea will be given for the best translation into English of the following extract:—

L'idée de la mort est lente à naître; mais, une fois qu'elle a pénétré dans l'esprit de l'homme, elle n'en sort plus. Jadis son avenir était la vie; maintenant, de tous ses projets, la mort est le terme; ainsi dès lors elle intervient à tous ses actes: il songe à elle lorsqu'il remplit ses greniers, il la consulte lorsqu'il acquiert ses domaines, elle est présente quand il passe ses baux, il s'enferme avec elle dans un cabinet pour tester, et elle signe au bas avec lui.

La jeunesse est généreuse, sensible, brave . . . . et les vieillards la disent prodigue, inconsidérée, téméraire. La vieillesse est ménagère, sage, prudente . . . . et les jeunes hommes la disent avare, égoïste, poltronne.

Mais pourquoi se jugent-ils, et comment pourraient-ils se juger? Ils n'ont point de mesure commune. Les uns calculent tout sur la vie, et les autres tout sur la mort.

Il est critique, ce moment où l'horizon de l'homme change. Ces plages de l'air, naguère lointaines, infinies, se rapprochent; ces fantastiques et brillantes nuées deviennent opaques et immobiles; ces espaces d'azur et d'or ne montrent plus que la nuit au bout d'un court crépuscule . . . . Oh! que son séjour est changé! que tout ce qu'il faisait avait peu de sens! Il comprend alors que son père soit sérieux, que son aïeul soit grave, qu'il se retire le soir quand les jeux commencent. Lui même s'émeut; cette nouvelle idée travaille son cœur, elle y réveille le souvenir de beaucoup de paroles, de beaucoup de choses, dont il ne pénétra point jadis le lugubre sens ou le charme consolateur. TÖPFFER.

GERMAN COMPETITION.

The prize is awarded to *Falstaff*, the pseudonym of C. L. Ford, 3, Sydney Buildings, Bath.

First Class.—Skeers, Eicarg, Currente calamo, Frau Pastor, Bernadotte, Day Dawn, Godesberg, Mary Anne, Percy, Polly, M.F.C., Ladybird, Garnet, M.E.R., Elspeth, Echo, Margot, Tangenichts, Andromaque, C.E.M., Thundergay, Mayflower, O Mimosa San, Teufelsdröckh, Scallywag, Agaznog, Terry, Käthe, E.S. *Second Class.*—Nellie, Beginner, Méné, Yum-yum, Marmion, Amor, Hajji Baba, Erica, Middleton, Azul.

Prize Translation.

Petits-Crevés—such is the name given, as you know, in the technical slang of modern French to those more or less ridiculous *farceurs*, whose most energetic exertions know no higher aim than a solicitude to dress in the newest style, to dine at the Café Riche, to smoke cigars at a franc apiece, and to keep horses and hounds. There *are* Petits-Crevés who with years come to their senses, and cast the slough of jockey-life and club-life, of a perpetual do-nothing existence, in order to become rational human beings; but these rare exceptions have never really been your genuine Petits-Crevés.

They have played the dandy-fool simply out of a genial fit of humour, as Prince Henry of England personated the *mauvais sujet*; or else they were Petits-Creves from a sense of duty towards the requirements of the fashionable clique—without, however, feeling quite at home in their adopted character. In general, the Petit-Crevé is and remains a pitiable creature, utterly past reclaiming.

In the Cafe Tortoni sits a young man, whose body-linen is faultlessly clean and of unimpeachable quality; his coat fits like a glove; with well-trimmed fingers, the tips of which are crowned with long pink nails. This young man is Monsieur le Baron Benjamin Vaurien.

A Prize of Half a Guinea will be given for the best translation into English of the following extract:—

Dicht am herrschaftlichen Garten ging die Landstrasse vorüber, nur durch eine hohe Mauer von derselben geschieden. Ein gar sauberes Zollhäuschen mit rotem Ziegeldache war da erbaut. Dort war eben der Zolleinnehmer gestorben, der das alles sonst bewohnte. Da kam eines Morgens frühzeitig, da ich noch im tiefsten Schlafe lag, der Schreiber vom Schlosse zu mir und rief mich schleunigst zum Herrn Amtmann. Ich zog mich geschwind an und schlenderte hinter dem lustigen Schreiber her, der unterwegs bald da bald dort eine Blume abbrach und vorn an den Rock steckte, bald mit seinem Spazierstöckchen künstlich in der Luft herumfocht und allerlei zu mir in den Wind hineinparlierte, wovon ich aber nichts verstand, weil mir die Augen und Ohren noch voller Schlaf lagen. Als ich in die Kanzlei trat, wo es noch gar nicht recht Tag war, sah der Amtmann hinter einem ungeheuren Tintenfasse und Stössen von Papier und Büchern und einer ansehnlichen Perücke, wie die Eule aus ihrem Nest, auf mich und hob an 'Wie heisst Er? Woher ist Er? Kann Er schreiben, lesen, und rechnen?' Da ich das bejahte, versetzte er; 'Na, die gnädige Herrschaft hat Ihm, in Betrachtung Seiner guten Aufführung und besondern Meriten, die ledige Einnehmerstelle zugedacht.' Ich überdachte in der Geschwindigkeit für mich meine bisherige Aufführung und Manieren, und ich musste gestehen, ich fand am Ende selber, dass der Amtmann recht hatte. Und so war ich denn wirklich Zolleinnehmer, ehe ich mich's versah. VON EICHENDORF.

REPORT ON THE PRIZE COMPETITIONS.

There were 187 entries for the French Competition. This is by far the largest number we have ever had. The piece set contained few passages of exceptional difficulty; but many competitors did not notice that *pays* is used in its restricted and local sense. A somewhat large number, too, failed to make proper sense of *et que leurs âmes—assiette;* and not a few rendered *serein* as 'night-dew,' a meaning it could not possibly have in the passage given. The general merit of the translations is above the average.

The best German translation was submitted by 'Skeers,' the pseudonym of Mrs. Green, St. Budeaux Vicarage, Devonport; but as the competitor won the prize in September last, the prize this month cannot be awarded to her. (See Rule 4.)

The German extract was very well done. A few took *jockey-clublichs—Existens* a little too literally, and one competitor, a lady possibly, translated it as 'scented existence.' *Aus genialischer Launenhaftigkeit* might be translated 'as a freak of genius' The successful competitor has not quite hit the meaning of the phrase.

☛ ***Several Competitors were disqualified this month under Rules 2 and 3.***

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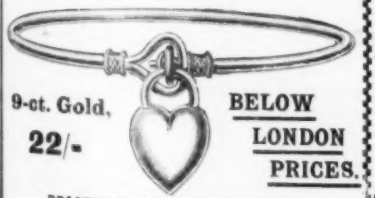

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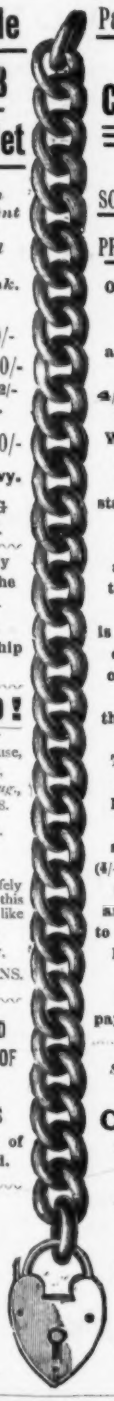

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